Deep Benthic Communities and Water Column Ephemeral Data Collections:
Deepwater Horizon Oil Spill (DWHOS)

Targeted Sampling Locations and Prioritization for the *HOS Sweetwater* Cruises 4 and 6 Sediment/Near-Bottom Water Sampling 14 July-30 July; 31 July – 7 Aug; 22 Aug – 1 Sept; and 10 – 25 Sept 2011

July 24, 2011

During the March/April 2011 *HOS Sweetwater* 2 cruise, near-bottom water, surface floc, and sediment cores were collected to assess the potential for MC252 hydrocarbons to accumulate in the slope sediments of surrounding salt domes and other bathymetric features in a "bathtub ring"-like pattern along with the possibility of fallout plumes of oil/sediment agglomerates accumulating in the immediate vicinity to the south/southwest of the wellhead. This plan is for a set of follow-on cruises to further investigate the accumulation of MC252 hydrocarbons in sediments, as well as to obtain background information on other sources of hydrocarbons, such as from seeps near the MC252 release area.

Preliminary observations from some of the *HOS Sweetwater* 2 samples suggested hydrocarbon presence in the sampled area as illustrated in Figures 1 and 2. In these figures, the previously occupied transects are shown as red lines, and the yellow icons denote stations where oil sheens or noticeable petroleum odors were detected either by visual inspection or by odor. Preliminary, verbal chemical analysis results and forensic fingerprinting were suggestive of MC252 oil in eight of the Near-Field Fallout Plume (FP) stations shown in Figure 2. Locations where Category 1 or 2 matches for MC252 oil were observed included: Stations 92 through 96 along Fallout Plume-0 (FP-0) and Stations 88, 90, and 91 along FP-1 as shown in Figure 2 (preliminary verbal reporting, S. Stout 20 May 2011). These categorical matches came from sediments from 0-1 cm, from surface floc, and from several samples of supernatant water collected above the sediment cores. Additional sediment and surface floc analyses are ongoing, but the results are not yet available. Thus, these preliminary results provide an incomplete picture of the distribution of MC252 hydrocarbons in the surface floc, sediments and near-bottom water at the sediment-water interface.

The purpose of the *HOS Sweetwater* 4 and 6 Cruises is to assess the potential for MC252 oil in sediments at locations immediately to the north as well as slightly further afield than the stations previously sampled in the vicinity of the Macondo well head during the *HOS Sweetwater* 2 Cruise. Like the earlier cruise, the choice of sampling stations includes those locations where: 1) there was potential contact of suspended and dissolved MC252 hydrocarbons with the continental slope and numerous bathymetric features (salt domes) in the plume depth horizon between 1400 and 1000 m, and 2) there was potential sediment deposition of MC252 hydrocarbons, down-current from the well head (recognizing that currents were directed in all cardinal directions at various times during the release, but most transport was to the southwest in late June and July, as indicated by ADCPs measuring deepwater currents in the

field). In addition, the cruise will allow near-bottom water, surface floc, and sediment core collections at stations further afield in support of red crab studies being planned to be undertaken by the Deepwater Communities Technical Working Group (TWG); and several transects are planned to allow early reconnaissance of selected seep locations to inform approaches to seep sampling and flux measurements later in the fall. To avoid confusion with the previous station locations occupied during legs 2 and 3 of the *HOS Sweetwater* 2 cruise, the proposed transects for this cruise plan (Figures 3 to 8) are identified as:

1. Fallout Plume transects: FP-6 through FP-11. These are the yellow fallout plume transects to the north of the wellhead in the relatively flat plain surrounded by Whiting, Mitchell and Gloria Domes (Figure 3).
2. Crab Transects: Crab Trans 1B, 1D, 1E, 2, and 6 (Figures 4, 5, and 6). Crab Trans 1B and 1D are transects to the north of the wellhead on and north of Whiting Dome, respectively; whereas Crab Trans 1E is to the east of Mitchell Dome. Crab Trans 2 is at the head of DeSoto Canyon approximately 100 km to the northeast of the wellhead and Crab Trans 6 is near Mississippi Canyon approximately 180 km to the southwest of the well head. Red crabs have historically been collected at each of these stations by Harriet Perry (USM, pers comm.). These stations are being occupied to provide sediment and floc concentration data in support of a separate cruise to these areas planned for later in the summer.
3. Surrounding Slope Stations (colored blue and designated as SLP-1, SLP-2, etc, Figure 6), to examine potential bath-tub ring-like or fallout accumulation further afield. These SLP transect locations were selected in areas where water depth is about 1000-1500m, in potential subsurface oil pathways within this depth range and between domes (based on possible water circulation patterns), and in deeper areas where oil fallout may have occurred (as indicated by AquaTracka and dissolved oxygen sag information collected in 2010 suggesting oil may have passed overhead, summarized in the OSAT I report). Some of these stations also pass near to locations of suspected seeps (Figure 7). Transects that identify a seep will provide accurate locations for a follow up dive to conduct an initial assessment of seepage to guide planning for subsequent seep expeditions. Slope transects SLP-13 through SLP-15 to the southwest of the well and SLP-9 northeast of the well are roughly evenly spaced in about 1000-1500m of water and in-route to crab stations 6 and 2, respectively. Short seep recognizance transects near seeps identified from acoustic data collected on the *Nick Skansi* November and December 2010 cruises or by Thomas Weber (UNH, pers. com, Jun 2011) based on acoustic data collected in summer of 2010. (See Figure 7, 8, TW indicates identified by Tom Weber; other seeps were identified on the *Nick Skansi* cruises).

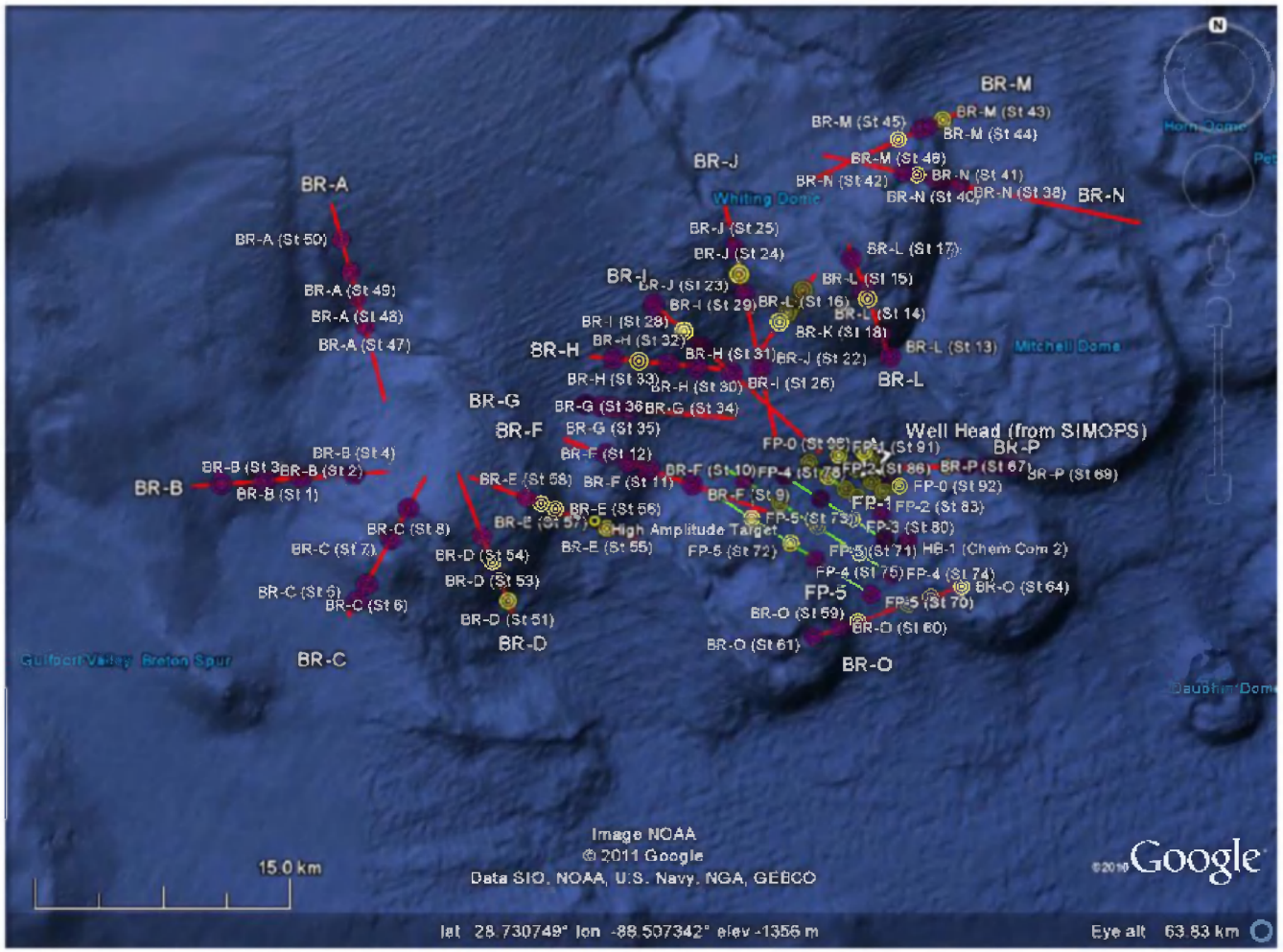

Figure 1. *HOS Sweetwater* 2 Bathtub Ring (red) and Fallout Plume (green) transects and station locations. Yellow station icons represent samples with visible oil sheen or detectible petrochemical odor, and purple icons denote sediments that appeared un-oiled based on on-board observations. No quantitative results are available.

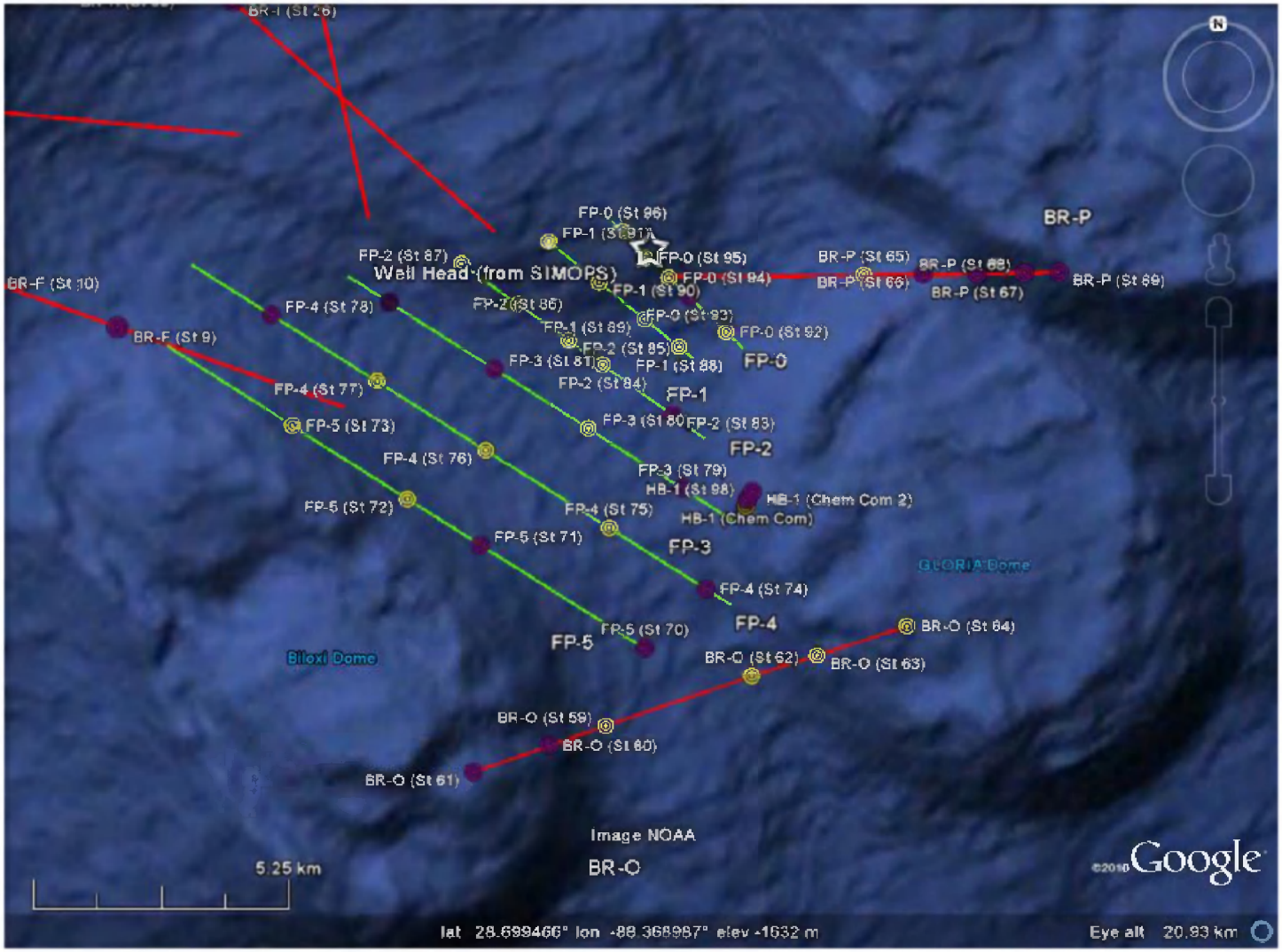

Figure 2. Close up of Fallout Plume (FP) transects from *HOS Sweetwater* 2 cruise showing locations of visible oil or petroleum odor (denoted by yellow station icons) based on on-board observations. No quantitative results are available. MC252 oil was identified in preliminary, verbal reporting of analysis results at stations 92-96 along FP-0 and Stations 88, 90, and 91 along FP-1.

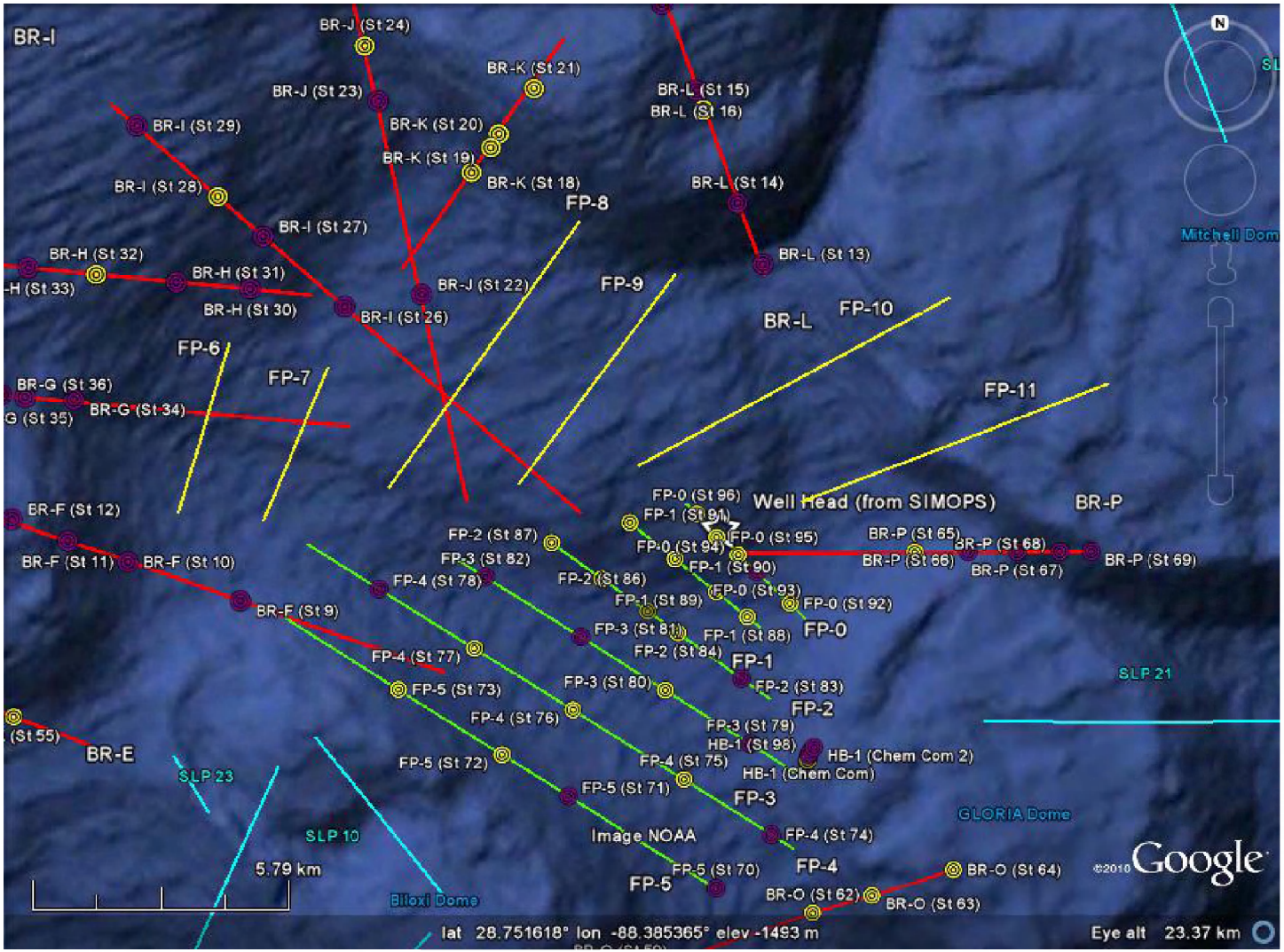

Figure 3. Close up of proposed Fallout Plume (FP) Transects 6 through 11 (yellow) *immediately* to the north of the wellhead in the hemisphere generated by Mitchell and Whiting Domes. *HOS Sweetwater* 2 stations are still shown for reference.

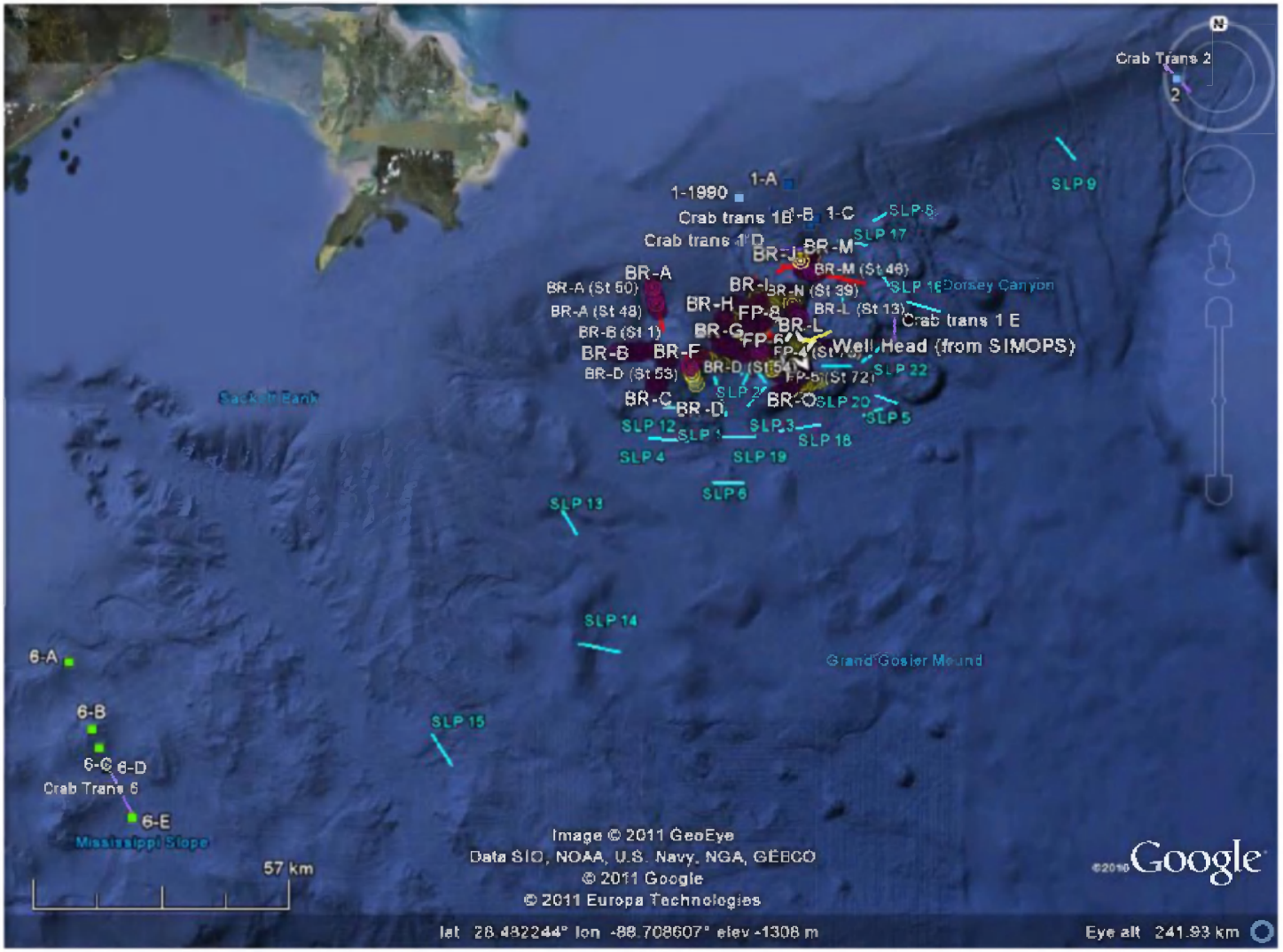

Figure 4. Proposed *HOS Sweetwater* Cruise 4 and 6 far-field crab transects *6 and 2 (*purple) and slope samples (blue).

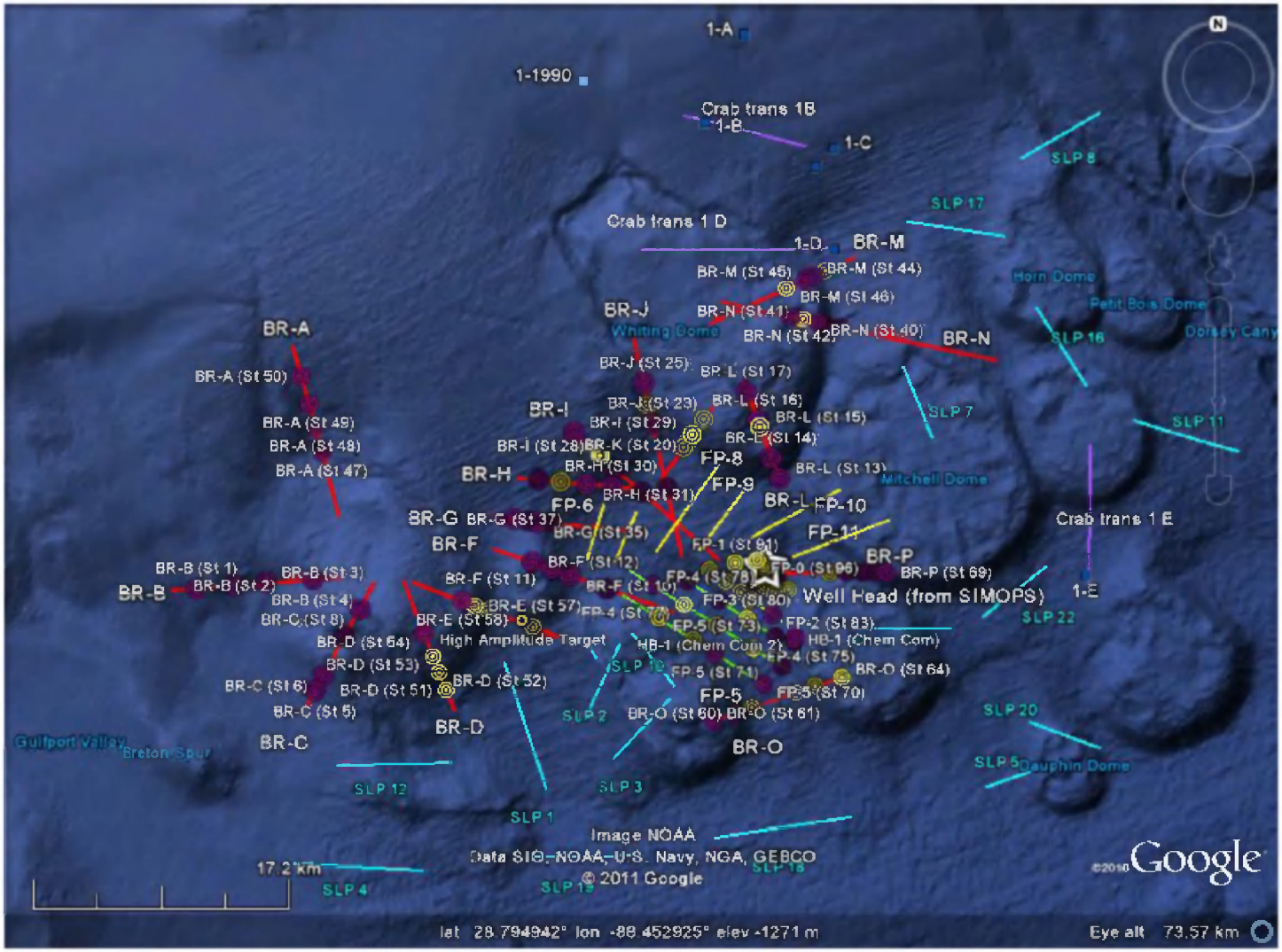

Figure 5. Proposed *HOS Sweetwater* Cruise 4 and 6 near-field crab transects 1B, 1D, and 1E (purple) and near-field slope transects (blue). The brown star icons represent potential seep recon sites on Dauphin Dome (DD), Biloxi Dome (BD), and Gloria Dome (GD). *HOS Sweetwater* 2 stations are still shown for reference (see Figures 6 and 7 for *HOS Sweetwater* 4/6 stations only).

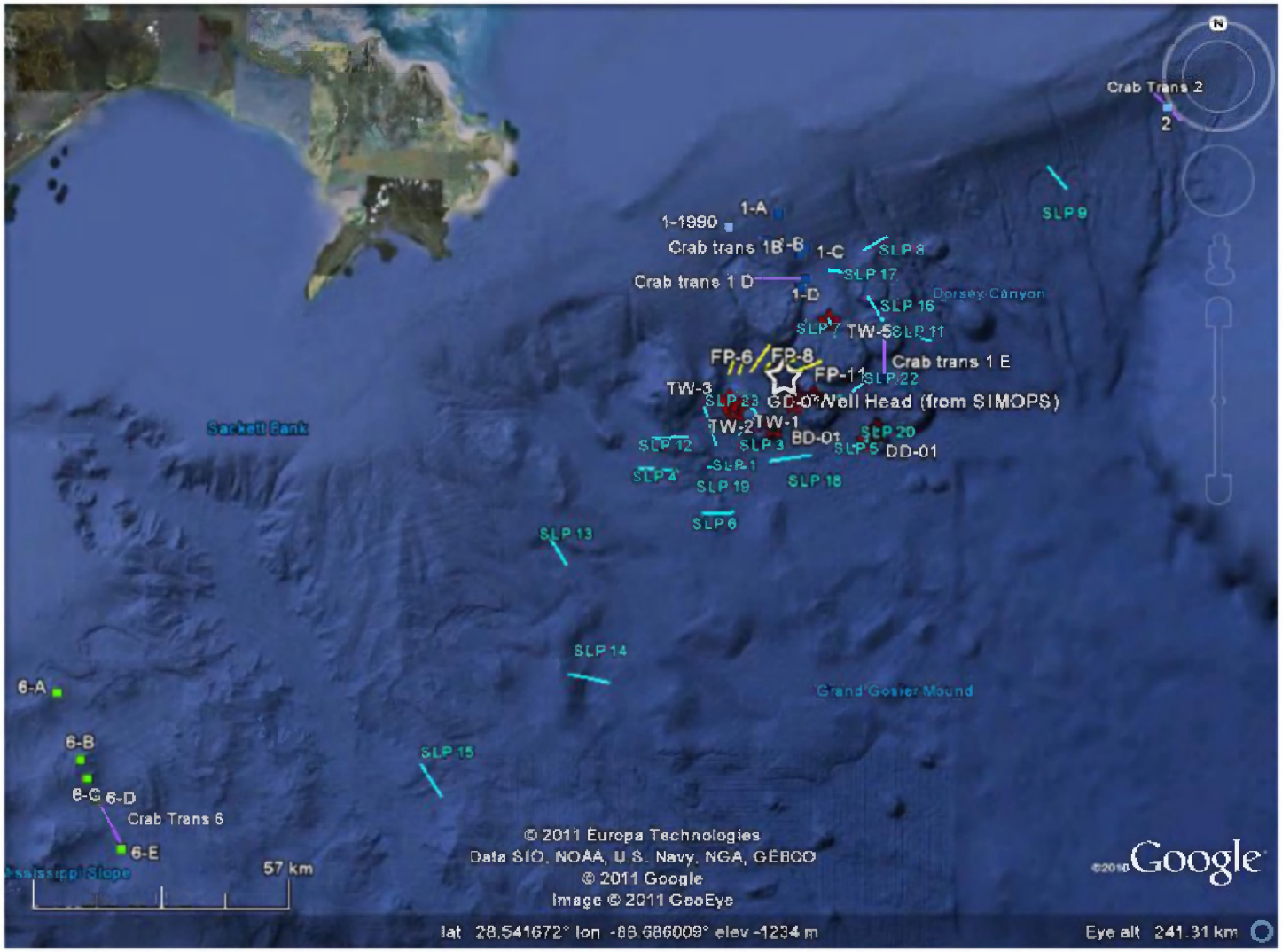

Figure 6. Overview of all proposed *HOS Sweetwater* Cruise 4 and 6 transects: fallout plume FP-6 to FP-11; crab transects 1B, 1D, 1E, 2 and 6 (purple) and slope transects (blue, SLP). The white star is the location of the wellhead.

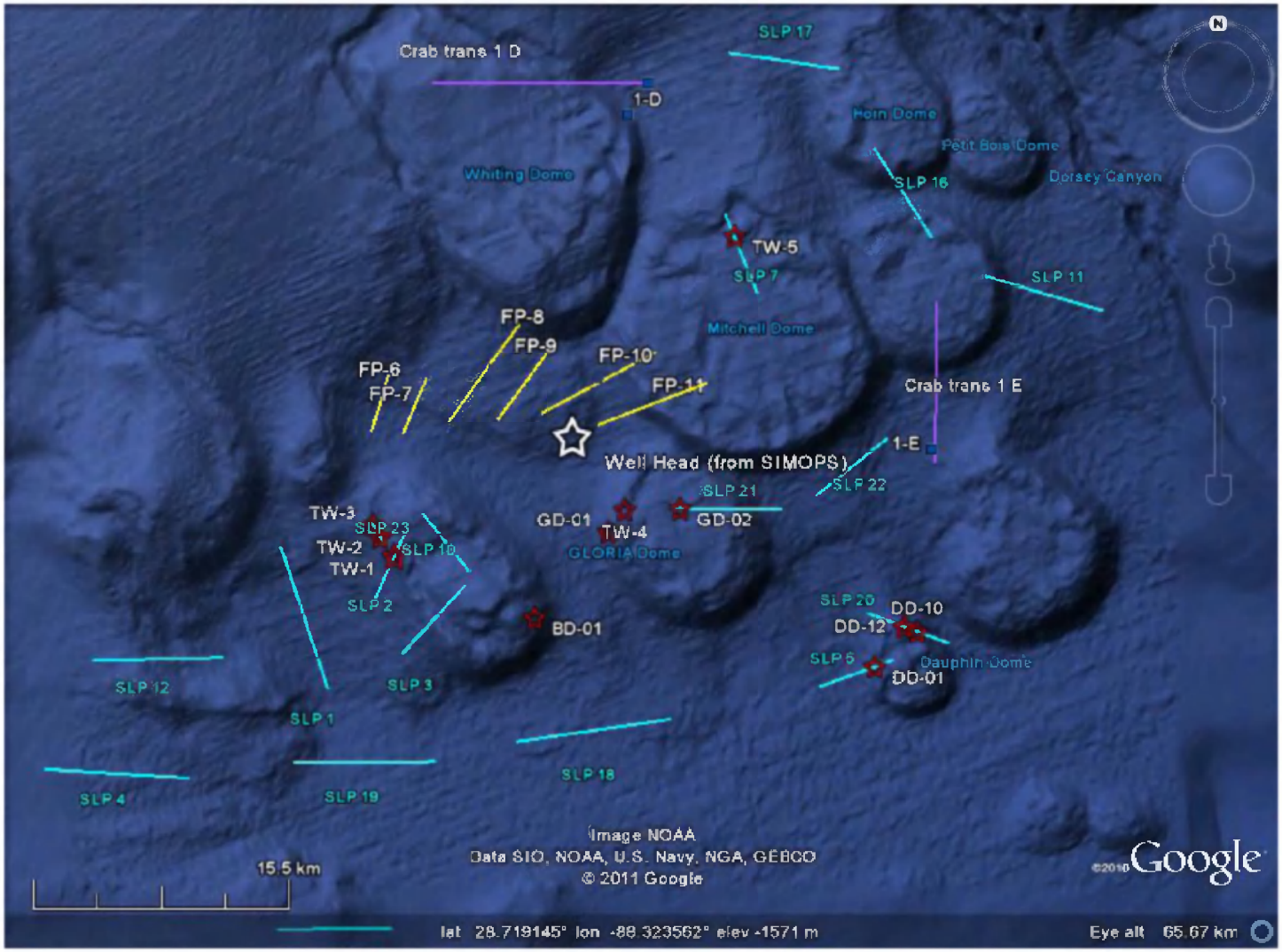

Figure 7. Proposed *HOS Sweetwater* Cruise 4 and 6 near-field transects: fallout plume FP-6 to FP-11; crab transects 1D and 1E (purple) and near-field slope transects (blue, SLP). The brown star icons represent potential seep recon sites on/near Dauphin Dome (DD-01, DD-10, DD-12), Biloxi Dome (BD-01, TW-1, TW-2 and TW-3), and Gloria Dome (GD-01, GD-02, and TW-4).

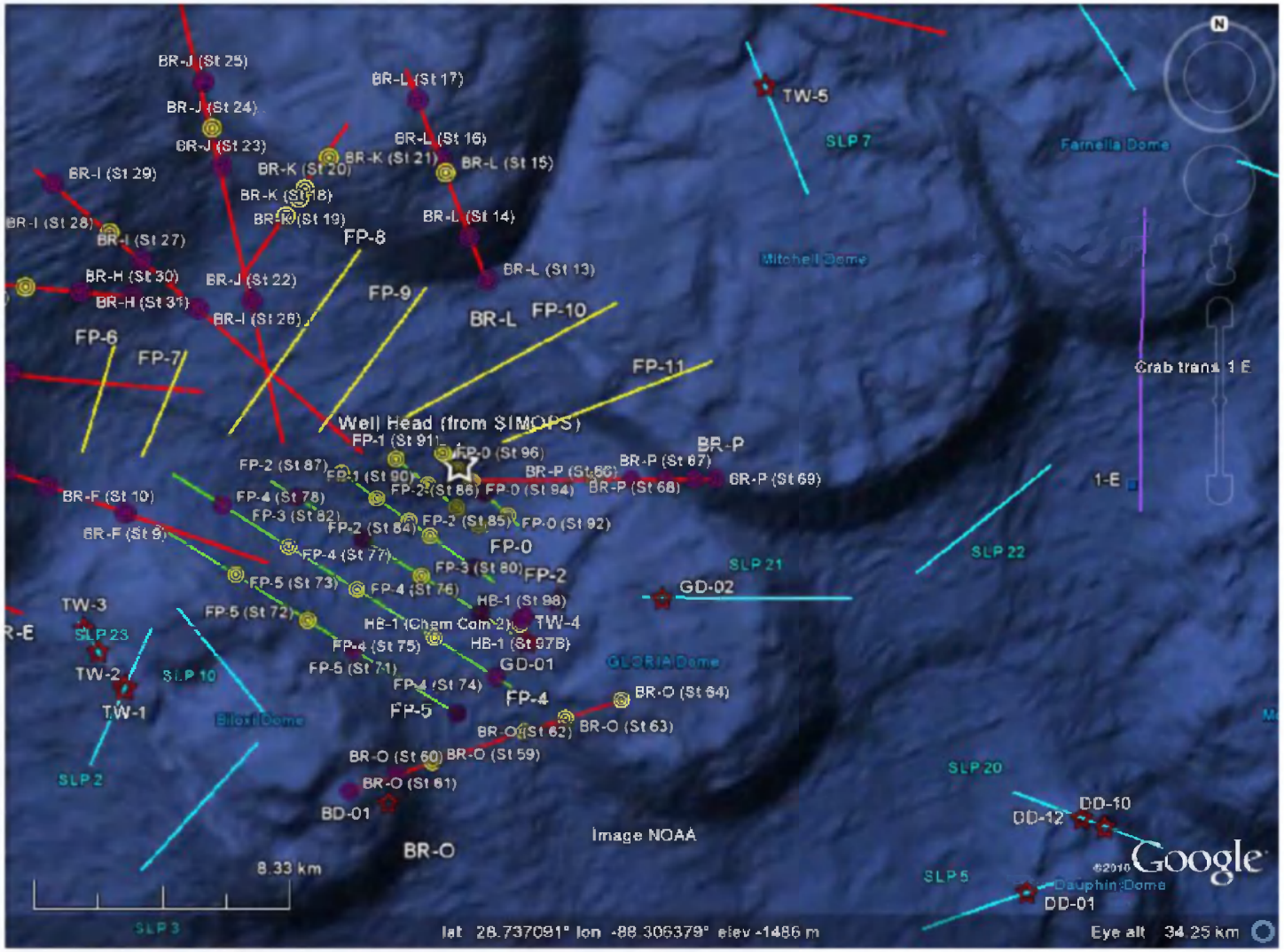

Figure 8. Close up of potential seep targets (brown stars) on Biloxi (TW-1, TW-2, and TW-3), Gloria (GD-02), Mitchell (TW-5), and Dauphin (DD-01, DD-10, and DD-12) Domes and associated SLP Transects planned for initial reconnaissance. *HOS Sweetwater* 2 sampling transects are also shown. See also Figure 7.

The sampling plan consists of three primary components as outlined above: transects of FP coring stations progressing in close proximity and to the north of the Macondo well head, transects of coring sites progressing up-slope (SLP) along bathymetric features further afield from the well head, and transects through areas where studies are being developed on red crab populations (Crab Trans). Six of the SLP transects will pass near to known seep sites, and if seeps are observed during those dives, the location will be noted for potential follow-on dives during this or future cruises. In summary, a total of six FP transects are proposed, 23 SLP transects, and five Crab-Trans transects (Figure 6). Six of the 23 SLP transects were positioned to pass by or over known or suspected seep areas (Figure 7), and they are intended to double as reconnaissance transects to identify measureable seeps. These will allow us to select up to six additional sites for more intensive seep dives involving short transects (during the present cruise or the first leg of Cruise 6 -- see below) for a total of 40 dive/transects.

As with the successful *HOS Sweetwater* 2 Cruise, we plan to conduct each transect as a single deployment and dive of the ROV. For each transect we plan to lower the ROV at the deepest station. If warranted (by AquaTracka and/or DO profiles) water-column samples may be collected at up to two depths during the descent. Upon reaching the sea floor the ROV will be released from the TMS, and it will be used to search out undisturbed sediment in the immediate vicinity to collect the first samples. The general locations of the preselected sampling locations are based on pre-dive examination of the cross-section profiles along the transect (Figure 9), where we look for depressions or flat parts where deposition might occur (with input from the on-board the BP/Cardno ENTRIX representative), while the precise location of sampling is determined in practice from the real-time video footage by the chief scientist in consultation with the ROV operator, as modulated by visibility and current flow. As the ROV moves into position, a sample of the bottom water will be collected with a GoFlo bottle mounted to the ROV, taking care not to sample flocculent material possibly kicked up by the ROV. If observed, floc previously-settled on the sediment surface (i.e., not resulting from ROV disturbance followed by settling) will be collected with the slurp gun until the filter approaches saturation and the flow rate slows, and then the ROV will slowly move into position and hover over the sediment to collect 3 push cores, for chemical analyses as described in the main text of the work plan. Once these three acts are performed, the HOS Sweetwater (while still on DP) will be directed to move in an up-slope direction (specific to each station – see Figure 9 for an example of the bathometric relief associated with these features) along the transect line at 0.2 to 0.3 knots. During this time, the ROV will typically be flown along the bottom, transmitting real-time video back to the ship for recording and observation by the Scientific Party (Chief Scientist and BP/Cardno ENTRIX representatives). Real time positioning and depth of the ROV will be tracked and recorded. The plan will be to collect sediment and additional water samples at four or five locations along the transect. With the real-time video feed, it will also be possible to sample anomalous features of obvious oil deposits along each transect. During each of the transects, red crabs and other megafauna may also be collected as they are observed and if conditions (visibility and positioning of the ROV) permit. These animals are considered samples of opportunity and the exact number to be collected on each transect will depend on the level of effort required, the number of animals observed, and the progress of the primary mission. Starting and ending positions for each transect are presented in Tables 1-3.

The six (intensive) seep transects will be performed using shorter transects than the slope (SLP) transects by performing a digital-video recorded radial-pattern grid search in the area of identified seepage (Figures 7 and 8). This will allow eight 250 m radials (each extending 250 m from the center point separated by 45 degrees) to be examined at each seep area, and then a modified sampling

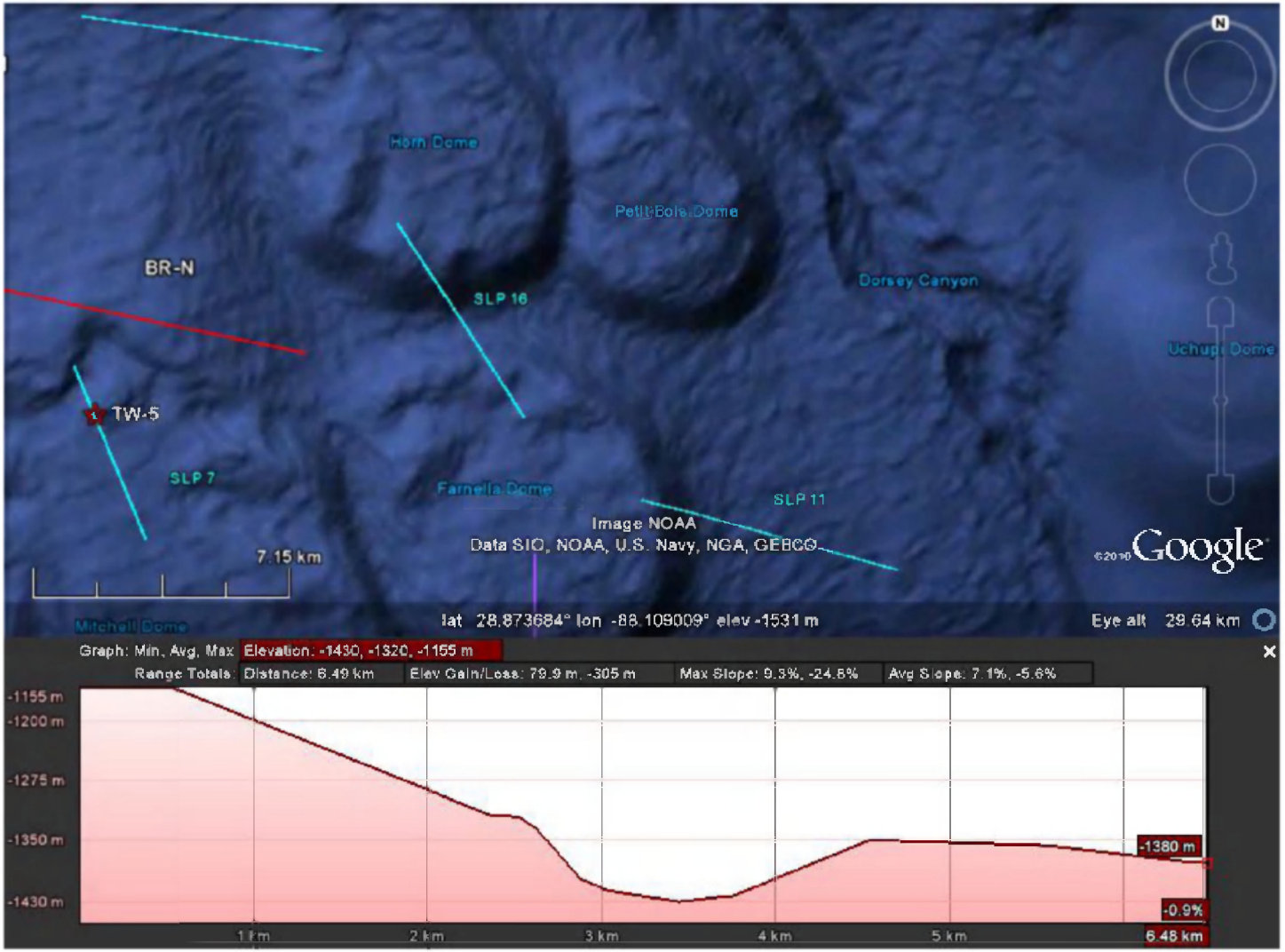

Figure 9. Cross section profile of Slope Transect SLP 16 between Horn Dome (left side of cross section) and Farnella Dome (right side).

procedure will be used along one of the radials selected by the Chief Scientist in consultation with the BP/Cardno ENTRIX representatives. Along this radial, near-bottom water and triplicate sediment samples will be collected near the seep and at distances of 10 m, 50 m, 100 m and 250 m (possibly down current or along another direction suggested by the local bathymetry or real-time observations). In this way a total of five additional stations will be located in the vicinity of each of up to six seep areas for an additional 30 stations sampled using established protocols. This sampling design will allow for a preliminary assessment as to the spatial extent to which seep hydrocarbons are incorporated into surrounding sediments, and will also provide samples for chemical analysis of hydrocarbons deposited in and around seeps.

We are not proposing the slurp sampling devise for the intensive seep studies, as recent flocculent deposition is not a focus for these stations. In addition, the slurp sampler will need to be removed from the ROV to allow for manipulation of the flux chamber with both manipulators at the seep sites.

Opportunistic sampling of red crabs and/or other megafauna will be performed during transits of the ROV as specimens are observed, and with sufficient lead time for the ROV to slow and move into an appropriate position without occluding visibility. Sampling of red crabs will be performed with the manipulator arm of the ROV by pinning the specimen to the sea floor, gripping it with the manipulator and depositing it in a bio-box mounted to the ROV. Other more-sedentary megafauna will be simply gripped and picked up, taking care to not damage the specimen to the extent possible given the equipment available.

The bio-box will be outfitted with malleable slits on the top such that the manipulator can fistulate the box to deposit the specimen inside. Prior to depositing the specimen inside the box several images will be taken such that multiple specimens can be differentiated should more than one individual be deposited into the bio-box (note that there is not sufficient payload for multiple bio-boxes). The use of the manipulator to collect crabs and other megafauna may be replaced by another method, should an advantageous method be identified. Protocols for processing any red crabs or other megafauna captured are described in Attachment 18.

The sampling approach and order (near-bottom water, settled floc, and finally triplicate sediments) will be completed at each station as it was during *HOS Sweetwater* 2, so even though there will be two Chief Scientists on sequential legs of the cruise, comparable samples will be collected throughout the effort. The general transect locations have been pre-selected (Tables 1-3), so the only activity left to the discretion of the Chief Scientists will be on station selection. As noted above, the general locations for station locations are based on examination of cross-sectional profiles along the transect before the dive, and criteria for station location along the transect during the dive will include: 1) soft sediment for coring; 2) observations of surface floc; 3) sufficient visibility; 4) observation of other features or anomalies (e.g., piles of drilling mud, accumulations or mucus-like oil agglomerates, etc.); 5) avoidance of other obstructions (pipelines or platform debris); and 6) the identification of active hydrocarbon seepage. Both Drs. Valentine and Payne have completed these types of operations previously, and following each day's dives, satellite telephone communications will be established between them and other members of the TWG to discuss findings and provide guidance to ensure continuity.

In order to complete this operation, the ROV/TMS will need to be equipped with ~15 sediment corers in easily accessible quivers mounted in the ROV basket. Likewise, a minimum of six 10-L Go Flo water bottles will need to be mounted on the ROV to enable matching of core samples with bottom waters at each station. The multi-chamber slurp gun system used during *HOS Sweetwater* 2, or an improved model, will also be needed to collect flocculent material. The capacity to capture red crabs during transects will also require modifications to the ROV payload including a storage bin and potentially a capture device.

By completing each transect as a single ~12-14 hour dive, we anticipate being able to complete one transect per 24-hour period, with sediment-sample sectioning, water sample filtration, and crab processing being completed on board the *HOS Sweetwater* within the wet-lab trailer on the aft deck. After sampling, the cores and water bottles will be washed and decontaminated (Attachment 4). The sample work up and equipment decontamination activities are anticipated to take 4-5 hours, which will also allow ROV personnel to attend to ROV/TMS maintenance and readiness operations preparing for the next dive, as well as transit to the next station.

Based on the sampling station plan (Figures 1-8; Tables 1-3), we plan to take sediment cores, slurp samples and water samples at up to 5 locations on each of 34 transects, i.e., at up to 170 stations along traditional transects plus up to 5 stations during star-shaped grids on 6 seep locations for an additional 30 stations. Near-bottom water sampling will also be completed at every station (i.e., 4-5 times along each transect within 1 m of the bottom before sediment sampling) and during the descent if warranted by the AquaTracka and DO/CTD data. Sediments at each station will be sampled in triplicate, but only one of three replicates will be analyzed initially with the other samples archived frozen for later analyses, if desired. All sediment cores will be sectioned into 5 layers: 1) near-bottom water; 2) 0-1 cm; 3) 1-3 cm; 4) 3-5 cm; 5) 5-7 cm. Only the upper four layers will be analyzed initially. Table 4 breaks out the sampling strategy, indicating the number of samples, containers, etc.

Including blanks, we will require 3000 (+ 26 for controls = 3026) 500 mL wide mouth sample bottles for frozen sediment core slices, 280 (+ 30 for controls = 310) 3.8 L (1 gal) Amber Jugs for filtered water samples, 280 (+ 30 for controls = 310) 125 mL Wide Mouth Jars for frozen SPM filter samples, 280 (+ 30 for controls = 310) 1 L Amber Glass Jars for whole water samples, 280 (+30 for controls = 310) 500 mL wide mouth sample bottles for slurp gun samples, 560 (+30 for controls = 590) 40 mL acidified VOA vials for VOA samples, and 1120 (+30 for controls = 1150) 15 mL Centrifuge Tubes for dispersant analysis. See Table 4 for additional details.

Table 1 ROV Transect Information for Slope (SLP) and Crab Transects

Name	Start_Lat	Start_Long	End_Lat	End_Long	Depth (m) at middle of transect
HSW 4 Slope 1	28.68136869	-88.54918904	28.60315185	-88.52035259	1576
HSW 4 Slope 2	28.69358956	-88.46898115	28.65319910	-88.49034723	1450
HSW 4 Slope 3	28.66016855	-88.43412772	28.62227406	-88.47408347	1433
HSW 4 Slope 4	28.55940893	-88.69577540	28.55438963	-88.60585949	1400
HSW 4 Slope 5	28.60355739	-88.21262758	28.61813289	-88.16620279	2035
HSW 4 Slope 6	28.47153736	-88.55149201	28.47197100	-88.48075195	1573
HSW 4 Slope 7	28.86241668	-88.27226134	28.81864338	-88.25193439	1247
HSW 4 Slope 8	28.98878632	-88.18963053	29.01657361	-88.13433522	1579
HSW 4 Slope 9	29.15287816	-87.76822109	29.11110878	-87.72693187	1253
HSW 4 Slope 10	28.69949376	-88.46051898	28.66750236	-88.43107254	1360
HSW 4 Slope 11	28.82854540	-88.10974257	28.80998171	-88.03489303	1727
HSW 4 Slope 12	28.61901402	-88.66557456	28.62057080	-88.58560715	1330
HSW 4 Slope 13	28.36705323	-88.85671461	28.43921667	-88.90732128	1288
HSW 4 Slope 14	28.15190657	-88.85291744	28.13437090	-88.75933240	1627
HSW 4 Slope 15	27.90742606	-89.13589730	27.97310310	-89.18309927	1404
HSW 4 Slope 16	28.89804257	-88.17955435	28.84924012	-88.14339174	1339
HSW 4 Slope 17	28.94981631	-88.26941780	28.94126315	-88.20064955	1117
HSW 4 Slope 18	28.58608647	-88.30622302	28.57375316	-88.40335896	1845
HSW 4 Slope 19	28.56300937	-88.45349455	28.56278360	-88.54226414	1720
HSW 4 Slope 20	28.64388777	-88.18232945	28.62718508	-88.13169008	1918
HSW 4 Slope 21	28.70142952	-88.23692542	28.70224529	-88.30701605	1506
HSW 4 Slope 22	28.70885515	-88.21529450	28.74044877	-88.17016001	1736
HSW 4 Slope 23	28.69549670	-88.49308429	28.68390216	-88.48508516	1381
Crab Trans 1B	28.99527401	-88.33955346	29.01366944	-88.42551985	735
Crab Trans 1 E	28.72690762	-88.14022213	28.81500434	-88.14038888	1738
Crab Trans 1 D	28.93364696	-88.31968573	28.93288595	-88.45389662	911
Crab Trans 2	29.30027035	-87.52530519	29.24477436	-87.46149166	847
Crab Trans 6	27.89674697	-89.90735722	27.79955298	-89.85087521	912

Table 2. ROV Transect Locations for Fallout Plume Survey

Name	Start_Lat	Start_Long	End_Lat	End_Long	Depth (m) at middle of transect
HOS SW 4 FP-6	28.74439582	-88.49226393	28.77858476	-88.48021010	1354
HOS SW 4 FP-7	28.74302785	-88.47273788	28.77377457	-88.45773638	1416
HOS SW 4 FP-8	28.74943820	-88.44406226	28.80286490	-88.40000904	1376
HOS SW 4 FP-9	28.75029160	-88.41411385	28.79237112	-88.37807737	1405
HOS SW 4 FP-10	28.75393121	-88.38678143	28.78748427	-88.31541412	1480
HOS SW 4 FP-11	28.74692187	-88.35131355	28.76922753	-88.28459654	1383

Table 3. Potential Seep Targets for Transects

Name	Latitude	Longitude	Depth (m)
GD-01	28.6893333	-88.3451333	1601
GD-02	28.7018833	-88.3003667	1487
BD-01	28.6423667	-88.3913500	1457
DD-01	28.6144333	-88.1779167	1987
DD-10	28.6337833	-88.1517167	1930
DD-12	28.6364667	-88.1596500	1914
TW-1	28.6761322	-88.4782504	1394
TW-2	28.6866843	-88.4869339	1381
TW-3	28.6933762	-88.4916034	1378
TW-4	28.7015656	-88.3350137	1540
TW-5	28.8502994	-88.2661768	1248

Table 4 HOS Sweetwater 4 and 6 Sediment/Water ROV Cruises

Station Numbers and Glassware Requirements

Leg 1 (D. Valentine)	Total Days	Operational Days	SLP Transects	FP Transects	Crab Transects	Seep Transects	Total Transects
14 July to 7 August 2011	24	22	12	3	2	3	20
Nominally 0.95 Transects/operational day							

Sample Matrix	Total Transects	Stations/Transect	Replicates/Station*	Depths/Core (Sediments)**	Total Samples	No of Bottles	Bottle Type	No of Bottles	Bottle Type
Sediment Samples	20	5	3	5	1500	1500	500 mL Wide Mouth		
Near-Bottom Water Samples (Filtered)	20	5	1		100	100	3.8 L (1 gal) Amber Glass Jug	200	Acidified 40 mL VOA
Near-Bottom Particulate Filters	20	5	1		100	100	125 mL Wide Mouth		
Near-Bottom Water Samples (Whole)	20	5	1		100	100	1 L Amber Glass	400	15 mL Centrifuge Tubes
Floc Samples (Slurp Gun)	20	5	1		100	100	500 mL Wide Mouth		
Slurp Samples of Opportunity	20	2	1		40	40	500 mL Wide Mouth		
Water Column Water Samples (Filtered)	20	2	1		40	40	3.8 L (1 gal) Amber Glass Jug	80	Acidified 40 mL VOA
Water Column Particulate Filters	20	2	1		40	40	125 mL Wide Mouth		
Water Column Water Samples (Whole)	20	2	1		40	40	1 L Amber Glass	160	15 mL Centrifuge Tubes

* Collect three sediment replicates, but only analyze one based on visual clues. The other two replicates will be held frozen for later analysis, if necessary.
** Surficial water, 0-1 cm, 1-3 cm, and 3-5 cm will be collected for analysis. A fifth sediment layer from 5-7 cm will be collected and archived (frozen), but not analyzed.

Total 500 mL Wide Mouth	1500	Frozen Sediment Core Slices
Total 3.8 L (1 gal) Amber Jugs	140	Filtered Water Samples
Total 125 mL Wide Mouth	140	Frozen SPM filter samples
Total 1 L Amber Glass	140	Whole Water Samples
Total 500 mL Wide Mouth	140	Slurp Gun Samples
Total 40 mL acidified VOA vials	280	VOA samples
Total 15 mL Centrifuge Tubes	560	Dispersant samples

Leg 2 (J. Payne)	Total Days	Operational Days	SLP Transects	FP Transects	Crab Transects	Seep Transects	Total Transects
22 Aug. - 1 Sept. & 10 Sept. - 25 Sept. 2011	26	22	11	3	3	3	20
Nominally 0.91 Transects/operational day							

Sample Matrix	Total Transects	Stations/Transect	Replicates/Station*	Depths/Core (Sediments)**	Total Samples	No of Bottles	Bottle Type	No of Bottles	Bottle Type
Sediment Samples	20	6	3	6	1500	1500	500 mL Wide Mouth		
Near-Bottom Water Samples (Filtered)	20	5	1		100	100	3.8 L (1 gal) Amber Glass Jug	200	Acidified 40 mL VOA
Near-Bottom Particulate Filters	20	5	1		100	100	125 mL Wide Mouth		
Near-Bottom Water Samples (Whole)	20	5	1		100	100	1 L Amber Glass	400	15 mL Centrifuge Tubes
Floc Samples (Slurp Gun)	20	5	1		100	100	500 mL Wide Mouth		
Slurp Samples of Opportunity	20	2	1		40	40	500 mL Wide Mouth		
Water Column Water Samples (Filtered)	20	2	1		40	40	3.8 L (1 gal) Amber Glass Jug	80	Acidified 40 mL VOA
Water Column Particulate Filters	20	2	1		40	40	125 mL Wide Mouth		
Water Column Water Samples (Whole)	20	2	1		40	40	1 L Amber Glass	160	15 mL Centrifuge Tubes

* Collect three sediment replicates, but only analyze one based on visual clues. The other two replicates will be held frozen for later analysis, if necessary.
** Surficial water, 0-1 cm, 1-3 cm, and 3-5 cm will be collected for analysis. A fifth sediment layer from 5-7 cm will be collected and archived (frozen), but not analyzed.

Total 500 mL Wide Mouth	1500	Frozen Sediment Core Slices
Total 3.8 L (1 gal) Amber Jugs	140	Filtered Water Samples
Total 125 mL Wide Mouth	140	Frozen SPM filter samples
Total 1 L Amber Glass	140	Whole Water Samples
Total 500 mL Wide Mouth	140	Slurp Gun Samples
Total 40 mL acidified VOA vials	280	VOA samples
Total 15 mL Centrifuge Tubes	560	Dispersant samples

					Additional bottles for Blanks	**Total Bottles**
Grand Total Bottle Supplies (for both Legs 1 and 2)	Total 500 mL Wide Mouth	3000	Frozen Sediment Core Slices		26	**3026**
	Total 3.8 L (1 gal) Amber Jugs	280	Filtered Water Samples		30	**310**
	Total 125 mL Wide Mouth	280	Frozen SPM filter samples		30	**310**
	Total 1 L Amber Glass	280	Whole Water Samples		30	**310**
	Total 500 mL Wide Mouth	280	Slurp Gun Samples		30	**310**
	Total 40 mL acidified VOA vials	560	VOA samples		30	**590**
	Total 15 mL Centrifuge Tubes	1120	Dispersant samples		30	**1150**

Grand Total Analyses Requested:	800	Frozen Sediment Core Slices	We are proposing to analyze the top four (water, 0-1cm, 1-3cm, 3-5 cm) from one core only and archive everything else.
	280	Filtered Water Samples	
	280	Frozen SPM filter samples	
	280	Whole Water Samples	
	280	Slurp Gun Samples	
	156	VOA samples (samples are collected in duplicate, but only one sample is analyzed).	
	1120	Dispersant samples	

Deep Benthic Communities and Water Column Ephemeral Data Collections:

Deepwater Horizon Oil Spill (DWHOS)

ROV Operations

February 25, 2011

Instrumentation:

Remotely Operated Vehicles (ROVs) are versatile tools used for many deepwater studies and tasks. They have previously been used as part of the NRDA sampling to observe oil and biota in the water column, trigger water bottles at various depths (in part based on observed oil layers), and conduct seabed surveys. Different systems are rated to different depths. Previous ROVs have been rated to 10,000 ft, the minimum requirement for the tasks described in this plan is 6,000 ft. The Canyon Triton XL ROV (Attachment 3) will be utilized in this plan. It is operationally rated for dives to 2500m.

Sampling Methodology:

The ROV and Tether Management System (TMS) are lowered over the side of a stationed vessel. The ROV and TMS are then lowered through the water column. The video cameras watch the water column, which is illuminated by the lights on the package – white lights for full illumination and black lights if looking for fluorescence of oil. When equipped with water bottles, the ROV fires the sampling mechanism on the water bottles at desired depths. At any point, the ROV can come out of the TMS and conduct horizontal surveys. This has previously been done at the bottom to document benthic conditions. However, this type of survey may also be conducted at mid-depths to document the horizontal extent of water column conditions or to evaluate biota.

Operator:

ROV operators are provided by the company leasing the ROV and the number required depends on the ROV used.

Vessel Requirements:

The ROV package should be self-contained and thus only requires sufficient deck space. The ROV package comes with a launch and recovery system (LARS) which includes a winch and cable capable of transmitting the data (including video) being collected in real-time and supporting the weight of the ROV. The LARS system varies with ROV type, but can be predicted to be less than approximately 10' x 15'. It is placed at the edge of the deck of the vessel where the gunwale has been removed. An additional control van and generator accompanies the ROV/LARS system. These also vary in size, but can be assumed to each be on the order of the size of the LARS.

Triton® XL
Specialty Marine Contracting
ROV System

CANYON
A HELIX ENERGY SOLUTIONS COMPANY

The 100-hp Triton XL system sets the standard for work-class ROVs in the industry. Exceptional durability, endurance and operational fexibility are the trademarks of this system.

The 3,000-kg through-frame lift of the Triton XL system provides a platform for a wide variety of tooling modules, including the most advanced and powerful tooling and trenching skids in the market.

The Triton XL system is equipped with power delivery, instrumentation and telemetry management systems to support turnkey construction operations in water depths up to 2,500 m.

Triton-class ROV systems are the most proven and reliable choice for subsea work applications and project support. Triton XL is a name synonymous with success in deepwater ROV operations around the world.

APPLICATIONS

The Triton XL offers a comprehensive combination of thrust, payload, through-frame lift and sensor interface. It supports virtually any offshore heavy-work requirement, including:

- Drill support
- Construction support
- Platform cleaning and inspection
- Subsea cable burial and maintenance
- Deepwater salvage
- Remote tool deployment
- Subsea pipeline completion
- Suction pile installation

Vehicle

- 100 hp
- Rated to 2,000 m (6,561 ft)
- Optionally rated to 2,500 m (8,200 ft)
- 300-kg (661-lb) payload

Dimensions

- Length: 3.18 m (10 ft, 5 in.)
- Width: 1.56 m (5 ft, 2 in.)
- Height: 1.98 m (6 ft, 6 in.)
- Weight in air: 3,262 kg (7,200 lb)
- 7 x Thrusters in quad format
- Altimeter
- 8 x Lights
- 1 x SIT or low-light CCD camera
- 1 x color zoom camera
- 1 x CCD B/W camera
- 1 x B/W camera
- Schilling T3 S/C manipulator
- Perry Slingsby Systems TA16 5-function manipulator
- Simrad 900D digital sonar system
- Strobe and locating beacon
- Fiber-optic multiplexing

Tether Management System (TMS)

- 183-m (600-ft) tether
- 1 x B/W camera

Dimensions

- Diameter: 1.9 m (6 ft, 4 in.)
- Height: 2.1 m (6 ft, 11 in.)
- Weight: 3,039 kg (6,700 lb)

Umbilical Winch/Launch and Recovery System (LARS)

Winch: Dynacon Model 521

- 100-hp winch
- Drum capacity: 2,702 m (8,861 ft, 5 in.)
- Umbilical length: 2,301 m (7,548 ft, 7 in.)
- 12 tonnes of safe working load

LARS: Dynacon 6021 A-Frame

- 9 tonnes of safe working load
- 20-tonnes capacity fully deployed
- Positive latch and rotation
- Self-erecting A-frame

A-Frame Dimensions

- Reach: 3.15 m (10 ft, 4 in.)
- Length: 12.8 m (42 ft)
- Width: 3.2 m (10 ft, 6 in.)
- Height fully extended: 8.84 m (29 ft, 2 in.)
- Height collapsed:3.29 m (10 ft, 8 in.)
- Weight (total): 20,400 kg (45,000 lb)

Control Cabin and Consoles

Dimensions

- Length: 6.1 m (20 ft)
- Width: 2.4 m (8 ft)
- Height: 2.6 m (8 ft, 6 in.)
- Weight: 10,900 kg (24,000 lb)

Workshop and Spares Cabin

Dimensions

- Length: 6.1 m (20 ft)
- Width: 2.4 m (8 ft)
- Height: 2.6 m (8 ft, 6 in.)
- Weight: 9,100 kg (20,000 lb)

Specifcations subject to change.
Winch and LARS weights vary by system.

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Deep Benthic Communities and Water Column Ephemeral Data Collections:
Deepwater Horizon Oil Spill (DWHOS)
ROV Benthic Sediment Core Collection
June 20, 2010

Sediment Sampling Methodology:

Sediment Corer

A sediment coring system will be mounted to the ROV. The sediment coring system consists of core tubes 6.5 cm in diameter (inside diameter) capable of taking samples down to a sediment depth of 10 cm (Figure 1). Up to sixteen core tubes will be mounted to the ROV frame during each dive descent and ascent. Once at the seafloor, the ROV actuates one core tube at a time and insert into the sediment. Each core tube is outfitted with a floating seal on the upper end (not inserted into the seabed). This floating seal allows water to flow out of the tube during insertion. As the tube is pulled from the seafloor the upper floating seal locks into place due to suction. This prevents loss of the sediment sample during recovery. The core is then retracted to its initial location and sealed at the bottom with a tension mounted foot plate. The mounts consist of a metallic surface and create a cap for the lower end of the tube inserted into the sediment. Thus, effectively both ends of the core tube are capped for ascent of the ROV.

Figure 1. Sediment core tube, floating seal cap (detached), and ROV core mount or holster.

Cores for Chemical Analysis

On deck in the ship's laboratory, cores will be extruded using a plunger system (see Sediment Core Extrusion: SOP's, Annex 1). Any surficial water trapped in the core tube will be carefully decanted into a clean 500 mL jar. Then, cross sections of sediment will be sliced from the core removing first the top flocculent layer (~1 cm), then slicing at 1-3 cm, 3-5 cm, and 5-7 cm down (from the original top of the core) targeting obvious color or texture changes for divisions. The remaining sediment will be divided into segments no larger than 4cm; this will be dependant on total depth of core and may vary.

Cross sections will be placed in pre-cleaned glass jars and kept frozen until shipment to Alpha Analytical for detailed chemical analyses and fingerprinting. Sample horizons will be clearly labeled and documented in the sample log (see Annex 2).

Sampling Equipment Decontamination

Decontamination of each core tube will be carried out by washing equipment with soap and water on board between uses. Coring equipment and tubes will be rinsed with fresh water from the vessel, and then rinsed with seawater during descent on the ROV to the sampling site.

Sampling equipment visibly stained with oil or other hydrophobic material will be further decontaminated before use to minimize cross-contamination. While performing the decontamination procedure, phthalate-free gloves, such as nitrile, will be worn. Sampling equipment will be decontaminated in the area designated for decontamination.

The decontamination procedure will proceed as follows:

- Wash and scrub core tubes with detergent
- Tap water/distilled water rinse
- An acetone only rinse or a methanol rinse (solvents must be pesticide grade or better) with an optional hexane rinse if necessary after contact by the equipment with visibly contaminated media that prevents complete decontamination at trace levels using the standard procedure.
    - Used solvents will be recovered, stored on board, and disposed of properly when the cruise vessel returns to land.
- Thorough de-ionized (analyte-free) water rinse (if available; otherwise use distilled water)
- Wrap core caps/ends and other sampling equipment that will come into contact with sample matrices in aluminum foil, shiny side out. Remove the aluminum foil before deployment with the ROV.

Sampling equipment being used to collect samples for polycyclic aromatic hydrocarbon (PAH), total extractable hydrocarbon (TEH), or volatile organic carbon (VOC) analyses will utilize the methanol rinse.

Solvents used during decontamination activities (e.g., methanol, acetone, hexane) will be collected and handled in accordance with the procedures outlined in the Vessel Safety Plan.

Sediment analysis will be by methods and for analytes described in the MC252 Analytical Quality Assurance Plan Version 2.2, Section 1.0 (Attachment 8). These are:

- Analysis and reporting for PAHs including alkyl homologues by gas chromatography with low resolution mass spectrometry using selected ion monitoring (GC/MS-SIM). The analytical procedure is based on EPA Method 8270D with the GC and MS operating conditions optimized for separation and sensitivity of the target analytes. Alkyl PAH homologues are quantified using a response factor assigned from the parent PAH compound. Analytes, associated response factors and target detection limits are listed in Table 1.1a.
- Analysis and reporting for saturated hydrocarbons by gas chromatography with flame ionization detection (GC/FID) based on EPA Method 8015. Analytes and target detection limits are listed in Table 1.1b.
- Acquisition of data by GC/MS-SIM for petroleum biomarkers listed in Tables 1.1e and 1.1f.

Total organic carbon (TOC) will be analyzed. Alpha Analytical has indicated that TOC can be analyzed with as little as 1g of sediment sample, but 5g is preferable.

***ROV Biota Collection*:**

Corals and associated megafauna may be collected during ROV transects for genetic analyses. The ROV will be mounted with 2-3 quivers (each quiver 12" tall X 4.5" bottom diam X-5 $^{5/8}$" top diam) that will be cleaned with aquinox, rinsed with DI, filled with DI, and then stoppered to prevent any possible contamination during descent. The biologist onboard will lead sampling efforts when the ROV discovers an area with corals. Before collection, each specimen will be properly imaged to examine branching pattern and to assess any potential damage (e.g., tissue sloughing, excess mucous production). The pilot will then guide the ROV manipulator arm to remove the rubber stopper on the quiver, break off a piece of the coral colony with associate, place into the quiver, and then re-stopper the quiver. More than one coral specimen and associate can be placed into a quiver as long as it is from the same locale. It will be ensured that the quivers will not be over-filled with specimens.

Upon retrieval of the ROV, the quivers will be removed from the vehicle and taken to the cold room where they can be stored while preserving. Each specimen will be photographed in a timely manner before preservation. For corals, 2-3 cm will be subsampled from each specimen and preserved in 2 cryovials, one with 95% EtOH (stored at -20°C) and the other with RNALater (storage at -80°C). A coral subsample will also be frozen in a cryovial at -80°C. A larger piece (ca. 5 cm) will be preserved as a voucher specimen. We will subsample (frozen at -80°C) for hydrocarbon load, if sufficient material (~30 g) is available. For associates, a 2-3 cm subsample will be placed in RNALater and the remaining specimen will be frozen for hydrocarbon analyses. Subsamples for hydrocarbon analyses will be wrapped in sterilized tinfoil. Hydrocarbon analyses will be dependent upon approval of subsequent work plans.

DNA will later be extracted from all specimens using a Qiagen DNeasy kit. COI+igr+msh, COI, or 16S/COI will be PCR amplified and sequenced for octocorals, hexacorals, and associated megafauna, respectively. The sequences will be blasted against the NCBI database and our existing Gulf of Mexico sequence database for genetic identification.

Annex 1. Sediment Core Extrusion: Standard Operating Procedures:

I. Purpose

This section describes the extrusion, sectioning and sample collection of discreet sediment layers after collection with the ROV sediment coring devices. This allows chemical analysis of different layers and isolation of freshly deposited materials from background contaminants.

II. Sampling Technique

During ROV assent, gather supplies and begin setup.
Need equipment/supplies:

- Table
- Aluminum foil
- Tongue depressors
- Wide-mouth 500ml sample jars
- Sample photo logs (appendix 1)
- Digital camera
- 5 gallon bucket
- Sediment core plunger
- Nitrile gloves

**Nitrile gloves should be worn at all times throughout sampling procedure

Process and photograph each sediment core completely before moving on to the next corer.

1. Station set up:
   1.1. Cover table surface work area with aluminum foil.
   1.2. Place bucket at end of table for disposal of excess sediment and materials.
   1.3. Make sure the boat is positioned so that the wind is coming from a direction that avoids blowing diesel exhaust into the sampling area.
2. Photograph 1: Entire corer.
   2.1. Each corer has a colored handle (top). This colored handle (top) should be included in the first photograph taken for each sample series.

Figure 2. Photograph 1 - Overview of complete corer including colored handle.

3. Photograph 2: Total core length
   3.1. Include cm scale in photograph to record total core length. Record total core length on sample log. (Table 1)

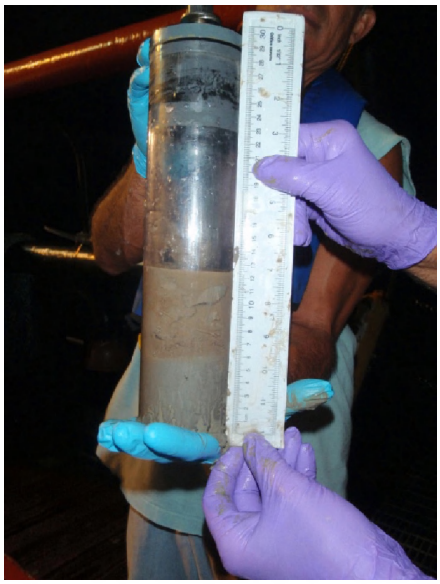

Figure 3. Photograph 2 - cm ruler adjacent to core before extrusion.

4. Remove top:
   4.1. Carefully remove handle of corer (top) while holding the bottom with a gloved hand.
   4.2. Insert plunger into bottom of corer.
      4.2.1. If there is an abundance of fluid on top of the sediment, this may be decanted and disposed of or sampled at the discretion of the lead scientist.
   4.3. Use plunger to slowly push entire contents of corer towards the top.
   4.4. Take another photograph with the cm ruler next to the core pushed up inside the core barrel.
5. Photograph 3: Top layer of sediment prior to collecting sample.
   5.1. Include labeled jar lid in this photograph.
6. **Include labeled lid in photograph for all subsequent layer samples** (i.e. each time a new layer is started).
   6.1. Lid should be labeled with a signifier that identifies the color of the corer (in this case "W" for white) and a letter/number that identifies the layer (here "A" for the topmost sediment layer.)
   6.2. This will help link photographs to the different cores and depths later on during photo processing.

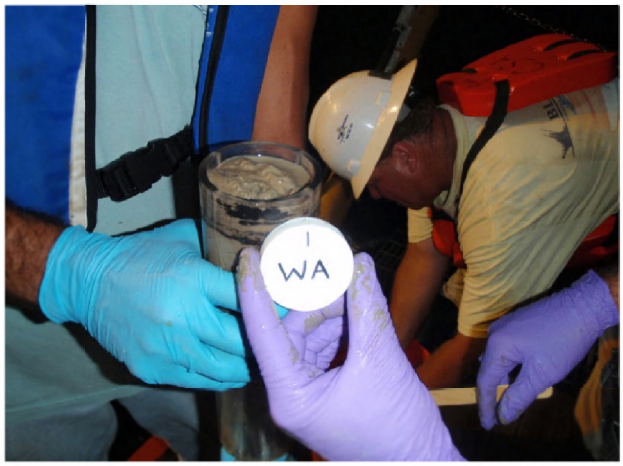

Figure 4. Photograph 3 - Upper layer before extrusion with labeled sample lid.

7. Sediment Sample 1:
   7.1. Use tongue depressor to collect top 1cm of sediment as first sample. In some cases, the top layer might have a "soupy" consistency and may require decanting into the sample jar. Include descriptions of the sample's length, odor, texture, and color on sample log (Table 1).
8. Sample 2:
   8.1. Use the plunger to extrude the next 2cm layer of sediment.
   8.2. Photograph layer with sample jar lid.
   8.3. Use tongue depressor to collect sediment into sample jar.
9. Sample 3:
   9.1. Use the plunger to extrude the next 2cm layer of sediment.
   9.2. Photograph layer with sample jar lid.

9.3. Use tongue depressor to collect sediment into sample jar.

10. Subsequent Samples:

10.1. The remaining sediment should be divided into segments no larger than 4cm. Any obvious change in sediment type (color, consistency, texture, etc) indicates the need for a new subsample and sample container.

10.2. In the event that the remaining sediment appears to be homogeneous, extrude the contents onto the aluminum foil and collect the center most 2cm segment as a representative sample (Photograph 4). Discard remaining portions into 5 gallon bucket.

Figure5. Photograph 4 - Extruded core bottom on Al foil for sub-sampling center section of homogeneous bottom layer.

11. Sample jars for sediment chemistry and TOC analyses should be labeled and stored in a freezer once sampling is complete.

Annex 2. Sediment core sample log and data sheet

Sediment Core Sample Log

Vessel	Total length
Cruise	Depth
Station ID	Sample Time
Date	

Corer Color (circle one) blue white yellow red

Sample ID	Layer Length	Texture	Odor	Sediment Color	photo number	photo time	comments

Water Column Injury Ephemeral Data Collections:
Deepwater Horizon Oil Spill (DWHOS)

Plan for Adaptive Water Column NOAA-NRDA Sampling (PAWNNS)
Chelsea Aquatracka Fluorometer
August 11, 2010

Instrumentation:

The Chelsea UV Aquatracka is a submersible fluorometer which is specifically designed to monitor hydrocarbon concentrations. With and excitation wavelength of 239 nm and an emission wavelength of 360 nm, it is well suited to measuring dissolved polycyclic aromatic hydrocarbons (PAHs). The Aquatracka has a detection range of 0.01 to 10 ug/L. The Aquatracka can be used in profiling mode and is compatible with most Seabird CTDs. The instrument is rated to 6000 m, and so may be deployed to full ocean depth in the Gulf of Mexico.

Sampling Methodology:

The Aquatracka will be deployed as a part of the sensor package on a Seabird 19 Plus CTD. The CTD will be lowered on a conducting wire from a winch, to depths up to 2000 m (and possibly somewhat deeper to 2500m). The Aquatracka The data processing can be done using standard Seabird software and can provide real-time fluorescence data.

Water Sampling Protocols in Support of the Ephemera Cruise WATER SAMPLES

Sampling Objectives

- To determine the concentration of oil compounds in the water column.
- To determine the source via fingerprinting, the degree of weathering, and background levels.
- To document exposure of water-column organisms and validate toxicity models.
- To maintain the integrity the sample(s) during sampling, transport, and storage.

Sample Volume

Analysis	*Sample Volume*	*Reporting Limit*
Volatile Aromatic Hydrocarbons (VAH)* by GC/MS-SIM (collect in duplicate)	40 mL vials	0.1-1 µg/L (ppb)
Total Extractable Hydrocarbons (TEH) by GC/FID	1-Liter	15 µg/L (ppb)
PAH (including alkylated PAHs) by GC/MS-SIM	1-Liter	0.001 to 0.01 µg/L

*sometimes referred to as VOA or BTEX analysis

Sampling Equipment/Containers

- Collect VAH samples (wearing clean Nitrile gloves) by pouring directly from the collection device (4 or 5 L Go-Flow bottle or other sampler) into HCl-preserved 40 mL septum-capped vials. Ensure that there is no headspace (i.e., bubble) in the vial.
- Collect water samples for THC and PAH in glass containers, certified-clean to be organic-free (solvent rinsed). Amber glass is preferred. Leave headspace of about 1 inch for 1 L jars. If the Portable Large Volume Water Sampling System (PLVWSS) is used, the sample will first be processed by vacuum filtration through a 0.7 µm glass fiber filter as it is vacuum transferred from the Go Flow Bottle into the amber glass jug (see separate PLVWSS Protocol).
- Decontaminate samplers before each use (see separate QA Plan for the NRDA Cruise). Scrub with laboratory-grade detergent and clean water, followed with a triple clean-water rinse (distilled water from a local store is OK but laboratory grade, certified-clean DI water is better. If the rinse water is not available, clean "background" water from an up-current non-contaminated area may be used. If sampler is contaminate by an oil slick, an Alkanox wash followed by solvent rinse with isopropanol, methanol, or acetone is appropriate. If solvents are not available, decontamination with a dilute detergent solution and fresh water, followed by a DI water rinse is recommended. (See separate QA Plan for sampler decon and blank protocol/frequency.) Collect solvent wastes for proper disposal.

Sample Collection Methods

- So as not to include any surface oil, collect "near-surface" samples approximately 1 m below below the surface, as appropriate for weather conditions.

- Vessels will maneuver to sweep oil away from the area where the sampling equipment is to be deployed. Go-Flo bottles and jar samplers are deployed and retrieved in the closed position.
- Creat an entry opening in a local surface slick with a boat hook or pole prior to deploying the equipment, but being careful that the surface oil is not physically dispersed into the water column. Depending on the consistency of the slick, sweeping the area with sorbents may also be effective.
- On each cruise, try to sample the control/least oiled areas first, then more contaminated zones.

Preservation/Holding Times

- VAH (VOA vial): With no preservative the samples may be held for 7 days at 4°C in the dark. Addition of HCl can extend the holding time to 14 days at 4°C in the dark without loss of sample integrity.
- TEH and PAH: No preservative added. Can be held at 4°C in the dark for up to 7 days.
- Immediately place all water samples in cooler and keep at 4° C (do not freeze).
- Use packing material around containers to prevent breakage.
- Ship to the laboratory ASAP with complete COCs. They need at least one day to process prior to holding time expiration.
- **Volatile hydrocarbons** (benzene, toluene, ethylbenzene, and xylene, or BTEX). For oil spill applications, the standard EPA Method 8240 (purge & trap) should be modified by running the GC/MS in selected ion monitoring mode and expanding the scan list (retention times and ions) to include the higher alkylated (C3 and C4) benzenes. Detection limits should be 1 ppb for individual analytes; 0.1 ppb is possible.
- **Total hydrocarbons** (TEH). Often referred to as total petroleum hydrocarbons, but most methods do not differentiate among petroleum, petrogenic, and biogenic hydrocarbons. TEH by GC-FID (total area of FID gas chromatogram of combined f_1 and f_2 fractions after column chromatography) is often the preferred method because of the low detection limit (compared to other TEH methods) and the direct measurement of individual hydrocarbons. This method does not detect low boiling compounds (below n-C_8). For NRDA, TEH analyses generally will not provide the data needed to support calculation of toxic effects from PAH exposure, and will have to be corrected to equivalent PAHs. The TEH results, however, can be used to tract oil weathering and map extent of exposure of water column resources, if meaningful detection limits can be reached. So, get a copy of the GC "trace." Detection limits are usually higher than those needed for aquatic injury assessment.
- **Polycyclic aromatic hydrocarbons** (PAH). Since most of the toxicity in oil is due to the PAHs, it is often the preferred analysis for NRDA. However, PAHs are expensive and require special laboratory skills. If PAHs are to be measured, it is important that the analytes include the alkyl-substituted PAH homologs, in addition to the standard PAH "priority pollutants." This method is referred to as Modified EPA Method 8270, because the list of PAHs is expanded to include the alkylated homologs, using GC/MS in the selected ion monitoring (SIM) mode. Detection levels should be 1-2 ng/L (ppt) for individual PAHs to support injury assessment using toxicity thresholds. Have the lab also run the source oil.

Other Considerations

- Contamination by surface slicks is of great concern. Document presence of slicks, weather, wave conditions, etc. which might suggest sample contamination by surface oil.
- Be aware of sources of contamination on the sampling vessel (exhaust fumes, engine cooling systems, oily surfaces). Work up-wind of any exhausts. Segregate dirty/clean areas. Lay out clean substrates to work on and replace frequently.
- Collect background samples from clean sites representative of pre-oiling conditions, as well as areas not yet oiled but in the potential path of the oil.
- Any preservation chemicals should be provided by the lab.
- Use a computer or conceptual model of the extent of water-column contamination to determine the number and location of samples. Minimum guidelines are at least three samples per area of relatively uniform exposure or sub-waterbody. Also, sample along exposure gradients, starting in the cleanest zone, at regular intervals proportional to the exposure area.
- Sampling documentation including NRDA sampling forms, field notes, photos, photo logs, GPS track and ship logs are transferred to the NRDA Sample Intake team.

Contact the Chemistry TWG or James R. Payne at PECI for questions or additional information: jrpayne@sbcglobal.net (760) 942-1015; cell: (760) 613-7391

PORTABLE LARGE-VOLUME SEAWATER SAMPLING SYSTEM (PLVWSS)

05/05/10

PLVWSS Specifications, Sampling Protocols, and Power Requirements

Container	Contents	Dimensions (inches)	Weight (lbs)	Power Requirements
Cruise Box No.1	Vacuum pump, in-line charcoal filter and water trap, vacuum gauge, support rack for 1 gallon amber-glass bottles, Teflon® stopper and suction tubing	24¼ W x 21¾ D x 19½ H	60	110 volts AC (from ship's AC outlet or portable generator)
Cruise Box No. 2	14.2 cm stainless steel Millipore® filter holder, Tygon® tubing, Teflon® solvent squirt bottles for equipment rinsing, Pall-Gelman Sciences 14.2 cm glass fiber filters, electrical extension cord, stainless steel forceps and spatula for filter manipulation	23¾ W x 23 ¾ D x 21¼ H	50	None

INSTRUCTIONS FOR SAMPLE COLLECTION AND FILTRATION

1) Place the Tygon® sampling tubing attached to the upper side of the filtration unit into the water (for near-surface samples if direct suction sampling is desired) or attach to the sampling port of the Go Flow Bottle used to collect samples at depth.

2) Plug in the vacuum pump (there is no on/off switch), and hold the Teflon® stopper firmly in the neck of the sample bottle. DO NOT FORCE THE STOPPER COMPLETELY INTO THE BOTTLE. The Viton® O-ring on the stopper is intended to make the seal with the upper lip of the sample bottle. Forcing the stopper into the neck of the bottle may cause the bottle to break, and it will certainly make it difficult to remove the stopper at the termination of sampling operations.

3) Press the Viton® O-ring on the stopper onto the top lip of the amber-glass bottle until a vacuum reading of 20 to 24 inches of Hg is obtained on the vacuum gauge attached to the pump. If the stopper starts to get sucked into the sample bottle, gently pull it out part way while still maintaining 20 to 24 inches of vacuum. Hold the stopper in place until water can be observed bubbling about 3 to 4 inches from the top of the amber glass bottle. This entire process may take from 5 to 7 minutes.

4) At this point, carefully watch the upper water level to ensure that the bottle does not become completely filled. Also, watch the vacuum tubing running from the Teflon® stopper to the in-line charcoal filter and water trap to see signs of water droplets starting to be drawn across into the trap. Stop collecting the sample when the water level is about 2 to 3 inches from the top of the 1-gallon bottle or when frequent water droplets are observed going over into the in-line trap.

5) To stop sampling, simply pull up on the Teflon® stopper to break the vacuum seal with the sample bottle. DO NOT TURN OFF THE VACUUM PUMP FIRST. This can damage the vacuum pump, and cause back diffusion of materials trapped in the in-line water trap back into the sample.

6) After the seal with the sample bottle is broken and the vacuum pressure has dropped back to ambient, unplug the vacuum pump.

7) Disconnect the Teflon® stopper from the transfer tubing coming from the bottom of the Millipore® filtration unit and wrap both ends of the tubes from the two-holed Teflon® stopper with aluminum foil. Place the original cap from the amber-glass bottle back on the bottle to seal it. Leave the sample in the pump box for safe storage until all other sampling operations are secure.

8) Drain any excess water from the tube running from the bottom of the filtration unit before opening the Millipore® filter housing. This will prevent any of the filtered material (SPM, sand, and free oil droplets) from being washed off the filter when the unit is opened. After all the water has drained from the bottom of the filtration unit, cap the tubing with aluminum foil and wrap the tubing around the legs for temporary storage.

9) Open the Millipore® filtration unit and carefully remove the outer ¼-inch circle of the glass-fiber filter from the perforated blue support base. Discard the outer edge of the filter. Using the stainless steel forceps and spatula provided with the PLVWSS, carefully fold the filter (while still on the blue support base) in half (and then in half again) to make a quarter-pie shape and then one more time making an eighth of a pie wedge. This entire operation should be done with the filter still resting on the perforated blue support base.

10) Place the folded filter wedge into a 125 mL Certified-Clean I-Chem bottle, seal and label it. The filters may be stored on ice or frozen in the field, if dry ice is available. Store frozen.

11) If another water sample is to be collected right away, place another glass-fiber filter into the Millipore® filtration unit, return the filtration unit to the cruise box/container, and proceed to the next station.

Finally, put the filtered water sample in the 1-gallor amber glass jug in a refrigerator (4°C) or cooler with frozen Blue Ice packs for storage before transfer to the analytical laboratory. Alternatively, the dissolved-phase water sample may be preserved by acidification (pH < 2 with HCl) or poisoned with 50 to 100 mL of methylene chloride. Because of air-freight shipping considerations, preservation with refrigeration and shipment with Blue Ice is preferred, particularly if next-day air delivery to the laboratory is available.

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ANALYTICAL QUALITY ASSURANCE PLAN

MISSISSIPPI CANYON 252 (DEEPWATER HORIZON) NATURAL RESOURCE DAMAGE ASSESSMENT

Version 2.2

Prepared for:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

January 20, 2011

TABLE OF CONTENTS

VERSION 2.2 CHANGES FROM VERSION 2.1:

<table>
<tr><th>Page</th><th>Change</th></tr>
<tr><td>Cover</td><td>Updated version # & date</td></tr>
<tr><td>Acronyms</td><td>Inserted DOSS</td></tr>
<tr><td>4</td><td>Inserted discussion re: Corexit Indicator Compound analysis (see below)
Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in Table 1.1.g. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.</td></tr>
<tr><td>4</td><td>Corrected table reference – Table 1.1g to Table 6.1g</td></tr>
<tr><td>5</td><td>In table removed X from SHC/TEH for Tissue</td></tr>
<tr><td>7</td><td>Removed Water (TEH) from Target MDL</td></tr>
<tr><td>7</td><td>Added Target Reporting Limit for Water (TEH/TEM) at 200 ug/L</td></tr>
<tr><td>10</td><td>Added T22a-Gammacerane/C32-diahopane to Table 1.1e –Petroleum Biomarkers</td></tr>
<tr><td>11</td><td>Added Corexit Indicator Compounds table (Table 1.1g)
TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only (monitoring mass/charge ion)
<table><tr><td>2-Butoxyethanol (m/z 87, 75)</td></tr><tr><td>Glycol ether Isomers (m/z 59, 103)</td></tr><tr><td>Bis-(2-ethylhexyl) fumarate (m/z 112, 211)</td></tr></table></td></tr>
<tr><td>13</td><td>Corrected Greg Salata email address to gsalata@caslab.com</td></tr>
<tr><td>14</td><td>Added two rows to preservation and holding time table – Sediment for VOC, and Water for DOSS<table><tr><td>Section 3.1</td><td></td><td></td><td></td></tr><tr><td>Sediment for VOC</td><td>Refrigeration 4°+ 2C</td><td>14 days</td><td>Not Applicable</td></tr><tr><td>Water for DOSS</td><td>Frozen, 15mL plastic centrifuge tubes so entire container can be solvent rinsed</td><td>Not established</td><td>Not established</td></tr></table></td></tr>
<tr><td>14</td><td>Table under Section 3.1: Changed header “Holding Time for Extracts” to read “Holding Time to Analysis”</td></tr>
<tr><td>14</td><td>For VOC stated Not Applicable in “Holding Time to Extraction” and moved holding times to last column (Holding Time to Analysis)</td></tr>
<tr><td>14</td><td>In last column – changed the footnote numbers from “9” to “12”</td></tr>
</table>

<table>
<tr><th>Page</th><th>Change</th></tr>
<tr><td>14</td><td>Replaced the rows for Sediment and Tissue matrices with the rows below.
<table>
<tr><th>Matrix</th><th>Storage for Samples</th><th>Holding Time to Extraction</th><th>Holding Time to Analysis</th></tr>
<tr><td>Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC</td><td>Frozen; except Grain Size should not be frozen - store at 4°C ±2°</td><td>1 Year; except not applicable for grain size, total solids and TOC.</td><td>40 days from extraction[12]; except biomarkers grain size and TOC no holding time.</td></tr>
<tr><td>Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)</td><td>Frozen</td><td>1 Year</td><td>40 days from extraction[12]; except biomarkers and TEO no holding time.</td></tr>
</table></td></tr>
<tr><td>20</td><td>First line: changed 10X to 5X, removed "(whichever is lower)"</td></tr>
<tr><td>21</td><td>Changed Mass Discrimination MQO to read Ratio for the “concentration” (rather than raw area)</td></tr>
<tr><td>24, 25</td><td>Removed "Draft" from table titles</td></tr>
<tr><td>26</td><td>Table 6.1f: Changed “Grain Size” method description to the following:
Grain Size (apparent): ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.</td></tr>
<tr><td>26</td><td>Added web address for Plumb method reference;
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf</td></tr>
</table>

Acronyms and Abbreviations

%D	Percent difference
%R	Percent recovery
ASTM	American Society for Testing and Materials
BS/BSD	Blank spike/blank spike duplicate
CCV	Continuing calibration verification
CRM	Certified reference material
DISP	Dispersant
DOSS	Dioctylsulfosuccinate salt
DOT	U.S. Department of Transportation
DQO	Data quality objectives
EDD	Electronic data deliverable
EIP	Extracted ion Profile
EPA	U.S. Environmental Protection Agency
GC/MS-SIM	Gas chromatography with low resolution mass spectrometry using selected ion monitoring
GC-FID	Gas chromatography with flame ionization detection
LC	Liquid chromatography
MC 252	Mississippi Canyon 252 (Deepwater Horizon)
MDL	Method detection limit
MQO	Measurement quality objectives
MS/MSD	Matrix spike/matrix spike duplicate
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural resource damage assessment
OPA	Oil Pollution Act
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic aromatic hydrocarbons
PIANO	Paraffins, isoparafins, aromatics, napthenes, olefins
QA	Quality assurance
QAP	Quality assurance plan
QC	Quality control
RM	Reference material
RPD	Relative percent difference
RSD	Relative standard deviation
SHC	Saturated hydrocarbons
SOP	Standard Operating Procedures
TEH	Total extractable hydrocarbons
TEM	Total extractable matter
TEO	Total extractable organics
TOC	Total organic carbon
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compounds

INTRODUCTION

On April 20, 2010, a fatal explosion struck the Deepwater Horizon offshore oil platform approximately 50 miles off the Louisiana coast in the Gulf of Mexico, ultimately leading to the destruction of the platform and the connecting riser pipe to the seafloor a mile below the water surface, and the ongoing release of thousands of barrels of crude oil from the seafloor per day. The incident has been declared a Spill of National Significance by the U.S. Secretary of Homeland Security and a major spill response effort is in progress. The spill threatens a broad expanse of the U.S. Gulf Coast in addition to the natural resources in the path of the oil slick which has spread across thousands of square miles at sea. Federal and state natural resource trustees have begun collecting ephemeral data to support a natural resource damage assessment (NRDA). Currently, NOAA is the lead administrative trustee. Although a formal agreement has not yet been reached, BP America has indicated an interest in cooperating with the natural resource trustees in the damage assessment.

This Analytical Quality Assurance (QA) Plan describes the minimum requirements for the chemical analysis of the environmental samples that are collected in support of this NRDA. This plan does not address the actual field collection or generation of these samples. The scope of the laboratory work is twofold: (1) generate concentrations for key chemicals used in injury determinations for crude oil releases, and (2) produce more extensive chemical data to use in fingerprinting for source identification. The applicable chemicals, need and frequency of environmental sample analyses, quality control requirements, and data usage vary for these two purposes, although implementation of this plan enables both to be achieved. In recognition of these differences, sampling plans may reference the Analytical QA Plan and cite to specific tables of chemical analyses that are appropriate to the needs of the particular sampling effort.

The requirements specified in this plan are designed to: (1) monitor the performance of the measurement systems to maintain statistical control over the reported concentrations of target analytes and provide rapid feedback so that corrective measures can be taken before data quality is compromised and; (2) verify that reported data are sufficiently complete, comparable, representative, unbiased and precise so as to be suitable for their intended use.

The analytes of concern addressed in this QA Plan are polycyclic aromatic hydrocarbons (PAHs) including alkyl homologues, saturated hydrocarbons (SHC), total extractable hydrocarbons (TEH)[1], and volatile organic compounds (VOCs) and petroleum biomarkers. Additional analytes of concern are potentially toxic polar and non-polar components found within or formed from the dispersant agents utilized during the response to the incident, although the appropriate target analytes and methods are not yet established. A variety of matrices may be analyzed including water, filters, sediment/soil, tissues, vegetation, absorbent materials (e.g. Teflon nets, etc.), oils and oil debris. In addition to the primary analytes of concern, ancillary tests may include: percent moisture, total organic carbon (TOC) and grain size for sediment samples, and total extractable organics (TEO) for tissues. Additional tests not

[1] TEH is the total aromatic and aliphatic content as determined by GC-FID. If the sample extract is not "cleaned up" to remove biogenic material prior to the GC-FID analysis, then the result from the GC-FID analysis is termed Total Extractable Matter (TEM).

currently addressed in the QAP but may be of interest are: SARA (%Saturate, %Aromatic, %Resin, %Asphaltene) content in oil[2]; carbon, hydrogen, and nitrogen (CHN)[3] for sediments and particulate material in water. Performance criteria will be added to the QAP for additional tests when requested under the NRDA program.

The work plans and associated QA plans under which these samples were generated or collected are independent documents and not included or considered herein. This Analytical QA Plan describes the minimum requirements to be taken to provide for the chemical analyses (and associated physical normalizing parameters) of the previously generated or collected samples in a technically sound and legally defensible manner.

This Analytical QA Plan is consistent with the intent of NRDA regulations under OPA (33 U.S.C. §§ 2701 *et seq.)* and satisfies the requirements listed in the relevant EPA guidance for QA plans (USEPA 2002 and USEPA 2001) as far as the documents relate to analytical testing services. This QA plan will be revised as appropriate, as changes are made to the NRDA and the QA program.

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[2] SARA according to method published by Zumberge et al (2005) or equivalent. [Zumberge, J., J.A. Russell, and S.A. Reid . 2005. Charging of Elk Hills reservoirs as determined by oil geochemistry AAPG Bull. v. 89, pp. 1347-1371]

[3] CHN by micro elemental analyzer using the Dumas method of complete and instantaneous oxidation (flash dynamic combustion) at >1,000 °C following exposure of the sample to HCl fumes to remove inorganic carbon.

1.0 PROJECT DESCRIPTION

A number of laboratories will be analyzing samples associated with this NRDA. The intent of this plan is to present the minimum requirements for the performance criteria for the laboratories providing data in support of this investigation. The analytes of specific interest and brief descriptions of the analytical methods are as follows:

- PAHs including alkyl homologues by gas chromatography with low resolution mass spectrometry using selected ion monitoring (GC/MS-SIM). The analytical procedure is based on EPA Method 8270D with the GC and MS operating conditions optimized for separation and sensitivity of the target analytes. Alkyl PAH homologues are quantified using a response factor assigned from the parent PAH compound. Analytes, associated response factors and target detection limits are listed in **Table 1.1a.** The following references discuss the method options in further detail:

  Federal Register 40CFR300, Subchapter J, Part 300, Appendix C, 4-6-3 to 4-6-5 pp. 234-237.

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Page, D.S., P.D. Boehm, G.S. Douglas, and A.E. Bence. 1995. Identification of hydrocarbon sources in the benthic sediments of Prince William Sound and the Gulf of Alaska following the *Exxon Valdez* oil spill. *In*: *Exxon Valdez Oil Spill: Fate and Effects in Alaskan Waters, ASTM STP 1219*, P.G. Wells, J.N. Bulter, and J.S. Hughes, Eds, American Society for Testing and Materials, Philadelphia. pp 44-83.

  Kimbrough, K.L., G.G. Lauenstein and W.E. Johnson (Editors). 2006. *Organic Contaminant Analytical methods of the National Status and Trends Program: Update 2000-2006*. NOAA Technical Memorandum NOS NCCOS 30. p. 25- 37.

  Sauer, T.C. and P.D. Boehm. 1995. *Hydrocarbon Chemistry Analytical Methods for Oil Spill Assessments*. MSRC Technical Report Series 95-032, Marine Spill Response Corporation, Washington, D.C. 114 p.

  USEPA. 2008. *Test Methods for Evaluating Solid Waste, Physical/Chemical Method* (SW846).

  Wang, Z. and S.A. Stout. 2007. Chemical fingerprinting of spilled or discharged petroleum – methods and factors affecting petroleum fingerprints in the environment. In: *Oil Spill Environmental Forensics: Fingerprinting and Source Identification*. Z. Wang and S.A. Stout, Eds, Elsevier Publishing Co., Boston, MA, pp. 1-53.

- Saturate hydrocarbons by gas chromatography with flame ionization detection (GC/FID) based on EPA Method 8015. Analytes and target detection limits are listed in **Table 1.1b**.

- Total Extractable Hydrocarbons (TEH[4]) representing the total aromatic and aliphatic hydrocarbon content of sample extracts after silica gel clean-up and analysis by GC/FID (**Table 1.1b**). The result is reported based on integration of the FID signal over the entire hydrocarbon range from *n*-C9 to n-C44 and calibrated against the average alkane hydrocarbon response factor.

  If the sample extract does not receive any clean-up then the result will be reported as Total Extractable Matter (TEM) because the extract may contain non-hydrocarbon compounds. . Either TEH or TEM may reported by the laboratory depending on the handling of the extract.

- Standard volatile organic compounds (VOC) by GC/MS based on EPA Method 8260B but for aromatics hydrocarbons only. Analytes and target detection limits are listed in **Table 1.1c.**

- Extended list of VOCs for a specialized fingerprinting analysis of paraffins, isoparaffins, aromatics, napthenes, and olefins (PIANO) by GC/MS. Analytes and target detection limits are provided in **Table 1.1d** for this source identification list.

- Petroleum biomarkers by GC/MS-SIM. Two methods for the analysis of petroleum biomarkers are contained herein, viz., quantitative and qualitative. The difference between these two analyses is that quantitative analysis produces absolute concentrations of target analytes whereas qualitative analysis produced pattern, or fingerprints, only. The proposed target analyte list for quantitative biomarkers is provided in **Table 1.1e.** This list may be expanded if warranted. This method is discussed in further detail in:

  Murphy, Brian L. and Robert D. Morrison (Editors). 2007. *Introduction to Environmental Forensics*, 2nd Edition. Chapter 9, p. 389 – 402;

  Wang, Z.. Stout, S.A., and Fingas, M. (2006) Forensic fingerprinting of biomarkers for oil spill characterization and source identification (Review). *Environ. Forensics* **7(2)**: 105-146.

- Qualitative biomarker patterns may also be acquired using GC/MS-SIM with monitoring of selected ions (m/z) as provided in **Table 1.1f**. Since no concentration data are generated by qualitative analysis the results are reported as hardcopy PDF files of each ion over the appropriate retention time(s) and scale and included in the hardcopy data package produced by the laboratory.

- Corexit indicator compounds can be identified and (semi-) quantified by conventional GC/MS-SIM. The indicator compounds presently identified include: 2-butoxyethanol, three closely-eluting glycol ether isomers (reported together as a single analyte), and

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[4] Note that the term TEH is being used for the total hydrocarbon analysis. The term "Total Petroleum Hydrocarbon" (TPH) may be used to refer to TEH, in some instances. For this QAP, the term TEH is used to avoid confusion with state-regulated gasoline or diesel determinations, rather TEH is used to refer to the sum of hydrocarbons from C_9 to C_{44}.

bis-(2-ethylhexyl)fumarate (the latter of which is a thermal degradation product of DOSS formed in the GC injection port). These indicator compounds can be identified in samples prepared for alkylated PAH analysis using conventional solvent extraction and preparation. These indicator compounds can be analyzed for concurrently with the alkylated PAHs during the same GC/MS acquisition by adding appropriate ions to the file. Suggested ions for monitoring are listed in **Table 1.1.g**. Indicator compound identifications are confirmed by analyzing a Corexit standard (i.e., a mixture of Corexit 9500 and 9527) under the same conditions as used for samples by comparing ion patterns and GC retention times. Semi-quantitative results for these indicator compounds can be based on a normalized response factor of 1 (without surrogate correction), and then the concentrations reported flagged by the laboratory as semi-quantitative.

- Corexit 9500/9527 dispersant (DISP) by liquid chromatography (LC)/MS for quantitative assessment, particularly dioctylsulfosuccinate sodium salt (DOSS). Proposed measurement performance criteria are presented in **Table 6.1g**. Because the method is under development the laboratory may develop appropriate performance criteria based on past method performance.

- GC/MS may have use for qualitative assessments of solvent package components (e.g. glycol ethers) or primary degradation products of DOSS (alkyl diesters), pending further method development. Standard methods are not available for either technique but provisional analytical criteria and detection limits are under development.

Analyses will include a number of different sample matrices. Matrices that will be analyzed will be determined in sampling plans and may not include all analyses for each matrix. The following table provides a summary of which analyses may be applicable to each matrix (analyses may be added or deleted as warranted over time).

Matrix	PAH	SHC/TEH	BIOMARK	DISP	VOC
Water	X	X	X	X	X
Filters	X	X	X		
Sediment/Soil	X	X	X	X	X
Tissue	X		X	X	
Vegetation	X	X	X	X	
Inert Sorbent Materials	X	X	X	X	X
Oil/Oily Debris	X	X	X	X	X

TABLE 1.1a
Extended PAH (Parent and Alkyl Homologs) and Related Compounds

	Compound	RF Source[5]
D0	cis/trans-Decalin	
D1	C1-Decalins	D0 or tD0[6]
D2	C2-Decalins	D0 or tD0
D3	C3-Decalins	D0 or tD0
D4	C4-Decalins	D0 or tD0
BT0	Benzothiophene	
BT1	C1-Benzo(b)thiophenes	BT0
BT2	C2-Benzo(b)thiophenes	BT0
BT3	C3-Benzo(b)thiophenes	BT0
BT4	C4-Benzo(b)thiophenes	BT0
N0	Naphthalene	
N1	C1-Naphthalenes	N0
N2	C2-Naphthalenes	N0
N3	C3-Naphthalenes	N0
N4	C4-Naphthalenes	N0
B	Biphenyl	
DF	Dibenzofuran	
AY	Acenaphthylene	
AE	Acenaphthene	
F0	Fluorene	
F1	C1-Fluorenes	F0
F2	C2-Fluorenes	F0
F3	C3-Fluorenes	F0
A0	Anthracene	
P0	Phenanthrene	
PA1	C1-Phenanthrenes/Anthracenes	P0
PA2	C2-Phenanthrenes/Anthracenes	P0
PA3	C3-Phenanthrenes/Anthracenes	P0

	Compound	RF Source
PA4	C4-Phenanthrenes/Anthracenes	P0
RET	Retene	RET or P0
DBT0	Dibenzothiophene	
DBT1	C1-Dibenzothiophenes	DBT0
DBT2	C2-Dibenzothiophenes	DBT0
DBT3	C3-Dibenzothiophenes	DBT0
DBT4	C4-Dibenzothiophenes	DBT0
BF	Benzo(b)fluorene	BF or FL0
FL0	Fluoranthene	
PY0	Pyrene	
FP1	C1-Fluoranthenes/Pyrenes	FL0 or PY0
FP2	C2-Fluoranthenes/Pyrenes	FL0 or PY0
FP3	C3-Fluoranthenes/Pyrenes	FL0 or PY0
FP4	C4-Fluoranthenes/Pyrenes	FL0 or PY0
NBT0	Naphthobenzothiophenes	
NBT1	C1-Naphthobenzothiophenes	NBT0
NBT2	C2-Naphthobenzothiophenes	NBT0
NBT3	C3-Naphthobenzothiophenes	NBT0
NBT4	C4-Naphthobenzothiophenes	NBT0
BA0	Benz[a]anthracene	
C0	Chrysene/Triphenylene	
BC1	C1-Chrysenes	C0
BC2	C2-Chrysenes	C0
BC3	C3-Chrysenes	C0
BC4	C4-Chrysenes	C0
BBF	Benzo[b]fluoranthene	
BJKF	Benzo[j,k]fluoranthene	BKF[8]
BAF	Benzo[a]fluoranthene	BKF or BAF

	Compound	RF Source
BEP	Benzo[e]pyrene	
BAP	Benzo[a]pyrene	
PER	Perylene	
IND	Indeno[1,2,3-cd]pyrene	
DA	Dibenz[a,h]anthracene	
GHI	Benzo[g,h,i]perylene	
4MDT	4-Methyldibenzothiophene	DBT0
2MDT	2/3-Methyldibenzothiophene	DBT0
1MDT	1-Methyldibenzothiophene	DBT0
3MP	3-Methylphenanthrene	P0
2MP	2/4-Methylphenanthrene	P0
2MA	2-Methylanthracene	P0
9MP	9-Methylphenanthrene	P0
1MP	1-Methylphenanthrene	P0
	2-Methylnaphthalene	
	1-Methylnaphthalene	
	2,6-Dimethylnaphthalene	
	1,6,7-Trimethylnaphthalene	
	Other	
	Carbazole	
	C30-Hopane[7]	

Target Method Detection Limit Range

Sediment/Soil = 0.1 – 0.5 ng/g dry weight
Tissue = 0.2 – 1.0 ng/g wet weight
Water = 1 – 5 ng/L

Target Reporting Limit

Oil = 2.0 mg/kg

[5] Response factor (RF) to be used for quantitation. If blank, compound is included in the calibration mix

[6] tD0 = transD0 (used if cis/trans in separate standards)

[7] Quantitative concentrations of C29-hopane and 18α-oleanane may be provided if laboratories are calibrated to do so; the C30-hopane is a minimum requirement.

[8] BKF = Benzo(k)fluoranthene. Benzo(j)fluoranthene and Benzo(k)fluoranthene coelute and will be reported as Benzo(j,k)fluoranthene (BJKF)

TABLE 1.1b
Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons

Abbr.	Analyte
nC9	n-Nonane
nC10	n-Decane
nC11	n-Undecane
nC12	n-Dodecane
nC13	n-Tridecane
1380	2,6,10 Trimethyldodecane
nC14	n-Tetradecane
1470	2,6,10 Trimethyltridecane
nC15	n-Pentadecane
nC16	n-Hexadecane
nPr	Norpristane
nC17	n-Heptadecane
Pr	Pristane
nC18	n-Octadecane
Ph	Phytane
nC19	n-Nonadecane
nC20	n-Eicosane
nC21	n-Heneicosane
nC22	n-Docosane

Abbr.	Analyte
nC23	n-Tricosane
nC24	n-Tetracosane
nC25	n-Pentacosane
nC26	n-Hexacosane
nC27	n-Heptacosane
nC28	n-Octacosane
nC29	n-Nonacosane
nC30	n-Triacontane
nC31	n-Hentriacontane
nC32	n-Dotriacontane
nC33	n-Tritriacontane
nC34	n-Tetratriacontane
nC35	n-Pentatriacontane
nC36	n-Hexatriacontane
nC37	n-Heptatriacontane
nC38	n-Octatriacontane
nC39	n-Nonatriacontane
nC40	n-Tetracontane

TEH	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 after silica gel cleanup.
TEM	$\Sigma(C_9\text{-}C_{44})$ Integration of the FID signal over the entire hydrocarbon range from n-C9 to n-C44 no silica gel cleanup.

	Target Method Detection Limit
Sediment (Alkanes) =	0.01 µg/g dry weight
Sediment (TEH) =	1 µg/g dry weight
Water (Alkanes) =	0.8 µg/L
	Target Reporting Limit
Oil (Alkanes) =	200 mg/kg
Oil (TEH) =	200 mg/kg
Water (TEH/TEM) =	200 µg/L

TEH = Total Extractable Hydrocarbons with silica gel "clean-up"
TEM = Total Extractable Matter with no extract "clean-up"

TABLE 1.1c
Standard Volatile Organic Compounds

Analyte
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
4-Isopropyltoluene
Benzene
Ethylbenzene
Isopropylbenzene
m,p-Xylenes
Naphthalene[9]
n-Butylbenzene
n-Propylbenzene
o-Xylene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Toluene

	Target Method Detection Limit Range
Sediment/Soil =	0.1 – 1 ng/g
Water =	0.05 – 0.5 µg/L
	Target Reporting Limit
Oil =	2 mg/kg

[9] Naphthalene is also included on the **Table 1.1a** target analyte list of PAH compounds. The PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1d
C5-C13 Volatile Compounds for PIANO Forensic Assessment

Abbrev.	Analyte
IP	Isopentane
1P	1-Pentene
2M1B	2-Methyl-1-butene
C5	Pentane
T2P	2-Pentene (trans)
C2P	2-Pentene (cis)
TBA	Tertiary butanol
CYP	Cyclopentane
23DMB	2,3-Dimethylbutane
2MP	2-Methylpentane
MTBE	MTBE
3MP	3-Methylpentane
1HEX	1-Hexene
C6	Hexane
DIPE	Diisopropyl Ether (DIPE)
ETBE	Ethyl Tertiary Butyl Ether (ETBE)
22DMP	2,2-Dimethylpentane
MCYP	Methylcyclopentane
24DMP	2,4-Dimethylpentane
12DCA	1,2-Dichloroethane
CH	Cyclohexane
2MH	2-Methylhexane
B	Benzene
23DMP	2,3-Dimethylpentane
THIO	Thiophene
3MH	3-Methylhexane
TAME	TAME
1H	1-Heptene/1,2-DMCP (trans)
ISO	Isooctane
C7	Heptane

Abbrev.	Analyte
MCYH	Methylcyclohexane
25DMH	2,5-Dimethylhexane
24DMH	2,4-Dimethylhexane
223TMP	2,2,3-Trimethylpentane
234TMP	2,3,4-Trimethylpentane
233TMP	2,3,3-Trimethylpentane
23DMH	2,3-Dimethylhexane
3EH	3-Ethylhexane
2MHEP	2-Methylheptane
3MHEP	3-Methylheptane
T	Toluene
2MTHIO	2-Methylthiophene
3MTHIO	3-Methylthiophene
1O	1-Octene
C8	Octane
12DBE	1,2-Dibromoethane
EB	Ethylbenzene
2ETHIO	2-Ethylthiophene
MPX	p/m-Xylene
1N	1-Nonene
C9	Nonane[10]
STY	Styrene
OX	o-Xylene
IPB	Isopropylbenzene
PROPB	n-Propylbenzene
1M3EB	1-Methyl-3-ethylbenzene
1M4EB	1-Methyl-4-ethylbenzene
135TMB	1,3,5-Trimethylbenzene
1D	1-Decene
1M2EB	1-Methyl-3-isopropylbenzene

Abbrev.	Analyte
C10	Decane[10]
124TMB	1,2,4-Trimethylbenzene
SECBUT	sec-Butylbenzene
1M3IPB	1-Methyl-3-isopropylbenzene
1M4IPB	1-Methyl-4-isopropylbenzene
1M2IPB	1-Methyl-2-isopropylbenzene
IN	Indan
1M3PB	1-Methyl-3-propylbenzene
1M4PB	1-Methyl-4-propylbenzene
BUTB	n-Butylbenzene
12DM4EB	1,2-Dimethyl-4-ethylbenzene
12DEB	1,2-Diethylbenzene
1M2PB	1-Methyl-2-propylbenzene
14DM2EB	1,4-Dimethyl-2-ethylbenzene
C11	Undecane[10]
13DM4EB	1,3-Dimethyl-4-ethylbenzene
13DM5EB	1,3-Dimethyl-5-ethylbenzene
13DM2EB	1,3-Dimethyl-2-ethylbenzene
12DM3EB	1,2-Dimethyl-3-ethylbenzene
1245TMP	1,2,4,5-Tetramethylbenzene
PENTB	Pentylbenzene
C12	Dodecane[10]
N0	Naphthalene[11]
BT0	Benzothiophene[11]
MMT	MMT
C13	Tridecane[10]
2MN	2-Methylnaphthalene[11]
1MN	1-Methylnaphthalene[11]

Target Detection Limit

Sediment/Soil = 0.1 – 10 ng/g

Water = 0.2 - 2.0 µg/L

Target Reporting Limit

Oil = 2 mg/kg

[10] These compounds are also included on the **Table 1.1b** target analyte list of saturate hydrocarbons. Because of the extraction technique, the GC-FID method for hydrocarbons is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both saturate hydrocarbons by GC-FID and VOC the result from the GC-FID analysis will be noted in the database as the preferred result.

[11] These compounds are also included on the **Table 1.1a** target analyte list of PAH compounds. Because of the extraction technique, the PAH analysis is the preferred method, rather than this volatile method. Thus, if a sample location is analyzed for both PAH and VOC the result from the PAH analysis will be noted in the database as the preferred result.

TABLE 1.1e
Petroleum Biomarkers for Quantitative Analysis

Compound *	Quant Ion m/z
C23 Tricyclic Terpane (T4)	191
C24 Tricyclic Terpane (T5)	191
C25 Tricyclic Terpane (T6)	191
C24 Tetracyclic Terpane (T6a)	191
C26 Tricyclic Terpane-22S (T6b)	191
C26 Tricyclic Terpane-22R (T6c)	191
C28 Tricyclic Terpane-22S (T7)	191
C28 Tricyclic Terpane-22R (T8)	191
C29 Tricyclic Terpane-22S (T9)	191
C29 Tricyclic Terpane-22R (T10)	191
18a-22,29,30-Trisnorneohopane-Ts (T11)	191
C30 Tricyclic Terpane-22S (T11a)	191
C30 Tricyclic Terpane-22R (T11b)	191
17a(H)-22,29,30-Trisnorhopane-Tm (T12)	191
17a/b,21b/a 28,30-Bisnorhopane (T14a)	191
17a(H),21b(H)-25-Norhopane (T14b)	191
30-Norhopane (T15)	191
18a(H)-30-Norneohopane-C29Ts (T16)	191
17a(H)-Diahopane (X)	191
30-Normoretane (T17)	191
18a(H)&18b(H)-Oleananes (T18)	191
Hopane (T19)	191
Moretane (T20)	191
30-Homohopane-22S (T21)	191
30-Homohopane-22R (T22)	191
T22a-Gammacerane/C32-diahopane	191
30,31-Bishomohopane-22S (T26)	191
30,31-Bishomohopane-22R (T27)	191
30,31-Trishomohopane-22S (T30)	191

Compound	Quant ion m/z
30,31-Trishomohopane-22R (T31)	191
Tetrakishomohopane-22S (T32)	191
Tetrakishomohopane-22R (T33)e	191
Pentakishomohopane-22S (T34)	191
Pentakishomohopane-22R (T35)	191
13b(H),17a(H)-20S-Diacholestane (S4)	217
13b(H),17a(H)-20R-Diacholestane (S5)	217
13b,17a-20S-Methyldiacholestane (S8)	217
14a(H),17a(H)-20S-Cholestane (S12)	217
14a(H),17a(H)-20R-Cholestane (S17)	217
13b,17a-20R-Ethyldiacholestane (S18)	217
13a,17b-20S-Ethyldiacholestane (S19)	217
14a,17a-20S-Methylcholestane (S20)	217
14a,17a-20R-Methylcholestane (S24)	217
14a(H),17a(H)-20S-Ethylcholestane (S25)	217
14a(H),17a(H)-20R-Ethylcholestane (S28)	217
14b(H),17b(H)-20R-Cholestane (S14)	217
14b(H),17b(H)-20S-Cholestane (S15)	217
14b,17b-20R-Methylcholestane (S22)	217
14b,17b-20S-Methylcholestane (S23)	217
14b(H),17b(H)-20R-Ethylcholestane (S26)	217
14b(H),17b(H)-20S-Ethylcholestane (S27)	217
C26,20R- +C27,20S- triaromatic steroid	231
C28,20S-triaromatic steroid	231
C27,20R-triaromatic steroid	231
C28,20R-triaromatic steroid	231

* Peak identification provided in parentheses.

Target Reporting Limit

Sediments/Soil = 2 ug/Kg dry weight
Waters = 10 ng/L

Target Reporting Limit

Oil = 2 mg/Kg

TABLE 1.1f
Suggested Hydrocarbon Groups and Petroleum Biomarkers for Qualitative Analysis

n-Alkycyclohexanes (m/z 83)
n-Alkanes (m/z 85)
Diamondoids (m/z 135, 187)
Sesquiterpanes (m/z 109, 123)
Isoprenoids (m/z 183)
Triterpanes (m/z 191)
Regular Steranes (m/z 217)
Rearranged β,β-steranes (m/z 218)
Methyl steranes (m/z 232, 245)
Methyl and triaromatic steroids (m/z 231)
Monoaromatic steroids (m/z 253)
Diasteranes (m/z 259)

TABLE 1.1g
Corexit Indicator Compounds for Qualitative Analysis in Water Only
(monitoring mass/charge ion)

2-Butoxyethanol (m/z 87, 75)
Glycol ether Isomers (m/z 59, 103)
Bis-(2-ethylhexyl) fumarate (m/z 112, 211)

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Assessment Manager

Greg Baker
Office of Response and Restoration
NOAA
345 Middlefield Road, MS-999
Menlo Park, CA 94025
(650)329-5048 FAX (650)329-5198
greg.baker@noaa.gov

The Assessment Manager is the designated natural resource trustee representative who is responsible for the review and acceptance of specific work plans and associated QA plans.

2.2 Project Coordinator

Mark Curry
Industrial Economics, Inc. (IEc)
2067 Massachusetts Avenue
Cambridge, MA 02140
(617) 354-0074 FAX (617) 354-0463
curry@indecon.com

The Project Coordinator is responsible for administration of the contracts with the laboratory(ies). The Project Coordinator will oversee the proper scheduling and transmittal of the data from the time of sampling to data reporting.

2.3 Quality Assurance

Ann Bailey is the QA Coordinator reporting directly to the Assessment Manager. Ms. Bailey is responsible for the implementation of this Analytical QA Plan. She will receive assistance in the coordination and performance of laboratory technical audits and independent data validation from the QA Contractor (EcoChem). The QA Coordinator has the authority and responsibility to cease or temporarily halt activities not in keeping with this QA Plan. The QA Coordinator will work closely with laboratory representatives and the project team to assure that project and data quality objectives are met. The QA Coordinator may be reached at:

Ann Bailey
EcoChem, Inc.
710 Second Avenue Suite 660
Seattle, WA 98104
(206)233-9332 x106 FAX (206)233-0114
abailey@ecochem.net

Cheryl Randle is a QA Reviewer conducting data validation on behalf of BP America. Ms. Randle is responsible for working closely with the Assessment Manager's QA Coordinator to assure the validity of the final data in accordance with this Analytical QA Plan. The QA Reviewer will conduct spot

validation of up to 25 percent of the reported data, unless substantial problems are discovered in which case up to 100 percent validation may be performed. The QA Reviewer may be reached at:

Cheryl Randle
ENTRIX, Inc.
1000 Hart Road, Suite 130
Barrington, IL 60010
(847)277-2865 FAX (847)381-6679
crandle@entrix.com

2.4 Analytical Laboratories

The laboratories planned to be contracted at this time for analytical work in support of the NRDA are TDI-Brooks B&B Laboratories (B&B), Newfields/Alpha Analytical (Alpha), and Columbia Analytical Services (CAS). The laboratory project managers are responsible for assuring that all analyses performed meet project and measurement quality objectives. The Laboratory Project Managers are:

Juan Ramirez
TDI-Brooks B&B Laboratories
1902 Pinon
College Station, TX 77845-5816
(979)693-3446 FAX: (979)693-6389
juanramirez@TDI-BI.com

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320 Forbes Boulevard
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508-844-4114:
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Greg Salata, PhD.
Columbia Analytical Services (CAS)
1317 S. 13th Ave.
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(360)577-7222
gsalata@caslab.com

As additional analytical laboratories are brought under contract this QAP will be updated to include their names and project managers.

3.0 SAMPLE HANDLING AND CHAIN OF CUSTODY PROCEDURES

Chain of custody procedures will be used for all samples throughout the analytical process and for all data and data documentation, whether in hard copy or electronic format. Sampling procedures, including sample collection and documentation, are part of the work plans of the individual projects and as such, are not considered here.

3.1 Sample Preservation and Holding Times

Sample preservation and field treatment of samples for analyses should be described in relevant field work plans. Based on EPA guidance, "advisory" sample holding times prior to analysis and holding times for the extracts are presented below. These holding times may be extended or preservation guidance changed, as options are assessed.

Matrix	Storage for Samples	Holding Time to Extraction	Holding Time to Analysis
Water for PAH, SHC/TEH, Biomarkers	Refrigeration 4°C ±2°; Optional: Preserved with 1:1 HCl to pH<2	7 days if not acid preserved; 14 days if acid preserved	40 days from extraction[12]; except biomarkers no holding time
Water for VOC	Refrigeration 4°C ±2° with no headspace; Optional: Preserved with HCl in the field in VOA vial.	Not applicable	7 days if not acid preserved; 14 days if acid preserved
Sediment for VOC	Refrigeration 4°C ±2°	Not applicable	14 days
Filters for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Sediment/Soil for PAH, SHC/TEH, Biomarkers, total solids, grain size and TOC	Frozen, except Grain Size should not be frozen – store at at 4°C ±2°	1 Year, except not applicable for Grain Size, Total Solids, and TOC	40 days from extraction[12]; except biomarkers grain size and TOC no holding time.
Tissue for PAH, SHC/TEH, Biomarkers, and Total Extractable Organics (TEO, aka Lipids)	Frozen	1 Year	40 days from extraction[12]; except biomarkers and TEO no holding time.
Vegetation for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Inert Sorbent Material for PAH, SHC/TEH, Biomarkers	Frozen	1 Year	40 days from extraction[12]; except biomarkers no holding time
Oil/Oily Debris for PAH, SHC/TEH, Biomarkers, VOC	Refrigeration <6°C	No holding time	40 days from extraction[12]; except biomarkers no holding time
Water for DOSS	Frozen, 15mL plastic centrifuge tubes	Not established	Not established

[12] 40 days is an advisory extraction holding time. Extracts should be held at -20C in the dark, and may be analyzed past 40 days and results not qualified if surrogates are within criteria.

3.2 Chain of Custody

Chain of custody records will be completed in ink.

A sample is considered in "custody" if:

- it is in the custodian's actual possession or view, or
- it is retained in a secured place (under lock) with restricted access, or
- it is placed in a container and secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

Samples are kept in the custody of designated sampling and/or field personnel until shipment.

3.4 Sample Shipping

Any transfer or movement of samples will use chain of custody procedures. The original signed and dated chain of custody record accompanies the sample(s); a copy is retained by the sample shipper. All shipments will comply with DOT regulations (*49CFR, Parts 172 and 173*).

3.5 Sample Receipt

Immediately upon receipt of samples, the recipient will review the shipment for consistency with the accompanying chain of custody record and sample condition, before signing and dating the chain of custody record. Sample condition(s) will be noted on the laboratory's sample receipt form and maintained with the chain of custody records. If there are any discrepancies between the chain of custody record and the sample shipment, the recipient will contact the sample shipper immediately in an attempt to reconcile these differences. Reconciliation of sample receipt differences will be maintained with the chain of custody records and discussed in the laboratory narrative which accompanies the data report.

3.6 Intra-Laboratory Sample Transfer

The laboratory sample custodian or designee will maintain a laboratory sample-tracking record, similar to the chain of custody record that will follow each sample through all stages of laboratory processing. The sample-tracking record will show the name or initials of responsible individuals, date of sample extraction or preparation, and sample analysis.

3.7 Inter-Laboratory Sample Transfer

Transfer of samples from one analytical laboratory to another, e.g. for grain size or TOC analysis, will follow chain of custody, sample shipping and receipt procedures described above. Transfer of samples between laboratories will be noted in the laboratory case narrative which accompanies the data report.

3.8 Sample Archival

All unanalyzed samples and unutilized sample aliquots or extracts will be held by the laboratory in a manner to preserve sample integrity at a secure location with chain of custody procedures for one (1) year after the QA Contractor has validated the data package for that particular set of samples. All archived materials will be accessible for review upon request. At the end of the archival period, the laboratory shall contact the QA Coordinator to obtain directions for handling remaining samples. The samples will not be disposed of by the laboratory unless provided with written approval from the Assessment Manager.

3.9 Data and Data Documentation

The laboratories will provide the QA Contractor with hardcopy data tables, QC documentation and instrument printouts suitable for QA assessment/data validation. Required laboratory deliverables are listed in **Table 7.1**. Data packages will include all related instrument print-outs ("raw data") and bench sheets. A copy of the data and data documentation developed by the laboratory for a given data package will be kept by the laboratory in a secure location using chain of custody procedures for five (5) years after the QA Contractor has validated that data package. All archived data and documentation will be accessible for review upon request. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

The original data will be transferred from the laboratory to the QA Contractor by means such that a signature is required at the time of document delivery. The QA Contractor will document receipt of packages and maintain a record of the method and date of data submittal with the complete data package. The QA Contractor will maintain the copy of the data packages and related validation documentation in a secure location for a period of one (1) year from the date of validation. These materials will become the responsibility of the Assessment Manager upon termination of the archival period.

4.0 LABORATORY OPERATIONS

All laboratories providing analytical support for the MC252 Damage Assessment must have the appropriate facilities to store and prepare samples, and appropriate instrumentation and staff to provide data of the required quality within the time period dictated. Laboratories are expected to conduct operations using good laboratory practices, including:

- Training and appropriate certification of personnel.
- A program of scheduled maintenance of analytical balances, laboratory equipment and instrumentation.
- Routine checking of analytical balances using a set of standard reference weights (ASTM class, NIST Class S-1, or equivalents).
- Recording all analytical data in secure electronic system with date and associated analyst identification, and/or logbooks with each entry signed and dated by the analyst.
- Monitoring and documenting the temperatures of cold storage areas and freezer units.

Laboratory operations may be evaluated by the QA Coordinator through technical systems audits, performance evaluation studies, and performance in a NIST-managed intercomparison program. Personnel in any laboratory performing analyses for this damage assessment should be well versed in good laboratory practices, including standard safety procedures. It is the responsibility of the laboratory manager and /or supervisor to ensure that safety training is mandatory for all laboratory personnel. The laboratory is responsible for maintaining a current safety manual in compliance with the Occupational Safety and Health Administration (OSHA) or equivalent state or local regulations. Proper procedures for safe storage, handling and disposal of chemicals should be followed at all times; each chemical should be treated as a potential health hazard and good laboratory practices should be implemented accordingly.

4.1 Quality Assurance Documentation

All laboratories must have the latest revision of the MC 252 NRDA Analytical QA Plan. In addition, the following documents and information must be current and available to all laboratory personnel participating in the processing of MC 252 samples:

- Laboratory Quality Assurance Management Plan
- Laboratory Standard Operating Procedures (SOPs) – Detailed instructions for performing routine laboratory procedures.
- Control charts or data tables – These must be developed and maintained throughout the project for appropriate analyses and measurements, including:
    - Alkyl PAH pattern book for MC252 reference oil.

4.2 Laboratory Systems Audits

Prior to or during sample analysis, QA systems audits will be performed. The laboratory audits will be conducted by the QA Coordinator or designee. The checklists used for the laboratory audits are based on requirements outlined in "Good Laboratory Practice Standards" (*40 CFR Part 792*) and audit procedures of the EPA National Enforcement Investigations Center, "NEIC Procedures Manual for the Contract Evidence Audit and Litigation Support for EPA Enforcement Case Development" (*EPA 330/9-89-002*). The Laboratory Project Managers will be informed of the findings and recommendations of the audit before the auditors leave the facility. A written report discussing the audits will be submitted to the Assessment Manager.

Additional laboratory audits may be performed at any time throughout the duration of the NRDA.

4.3 Participation in Intercomparison Exercises

Each analytical laboratory performing analysis will be required to participate in potential intercomparison exercises that may be organized by NS&T and/ or NIST during the duration of the laboratory's participation in this NRDA analytical program. A variety of samples including sample extracts and representative matrices (e.g., sediment or tissue samples) may be utilized in these exercises. Laboratories are required to analyze only those matrices or analytes that they are providing in like manner for the NRDA analytical program. When participating in the intercomparison exercise, the

laboratory should analyze the sample(s) in the same manner as routinely performed for this NRDA and as specified in this Analytical QA Plan. Laboratories which fail to achieve acceptable performance will be required to provide an explanation to the QA Coordinator and/or undertake appropriate corrective actions.

5.0 ASSESSMENT OF DATA QUALITY

The purpose of this Analytical QA Plan is to develop and document analytical data of known, acceptable, and defensible quality. The quality of the data is presented as a set of statements that describe in precise quantitative terms the level of uncertainty that can be associated with the data without compromising their intended use. These statements are referred to as Data Quality Objectives (DQOs) and are usually expressed in terms of precision, bias, sensitivity, completeness, and comparability.

5.1 Precision

Precision is the degree of mutual agreement among individual measurements of the same property under prescribed similar conditions, such as replicate measurements of the same sample. Precision is concerned with the "closeness" of the results. Where suitable reference materials (RMs) are available, precision will be expressed as the relative standard deviation (RSD) for the repeated measurements. This use of RMs allows for the long-term measurement of precision but does not include homogenization as a source of analytical variability.

In addition to the tracking precision of replicate RM analyses, precision will be expressed as the relative percent difference (RPD) between a pair of replicate data from environmental samples prepared and analyzed in duplicate.

5.2 Bias

Bias is the degree of agreement of a measurement with an accepted reference value and may be expressed as the difference between the two measured values or as a percentage of the reference value.

The primary evaluation of bias will be through the use of RMs. RMs with certified values (from NIST or a similar source) will be used if they are available. The laboratory will maintain control charts to track the RM performance. Spiked matrix samples will also be analyzed to assess bias for those analytes that are not available in suitable reference materials.

5.3 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relationship to another data set. Comparability of the chemical analytical data is established through the use of:

- Program-defined general analytical methodology (e.g., low resolution MS), detection limits, bias and precision requirements and reporting formats;

- NIST-traceable calibration materials;
- Reference material with each sample batch;
- Analysis of a common "reference oil".

5.4 Completeness

Completeness is a measure of the proportion of data specified in the sampling plan which is determined to be valid. Completeness will be assessed by comparing the number of valid sample results to the total number of potential results planned to be generated. The DQO for completeness is 95%, i.e. no more than 5% of the analytical data missing or qualified as unreliable (rejected).

6.0 QUALITY CONTROL PROCEDURES

No particular analytical methods are specified for this project, but the QA/QC requirements will provide a common foundation for each laboratory's protocols. This "common foundation" includes: (1) the specification of the analytes to be identified and quantified and the minimum sensitivity of the analytical methods and (2) the use of NIST reference materials, and (3) the use of a common MC252 Reference Oil.

Prior to the analysis of samples, each laboratory must provide written protocols for the analytical methods to be used; calculate detection limits for each analyte in each matrix of interest and establish an initial calibration curve in the appropriate concentration range for each analyte. The laboratory must demonstrate its continued proficiency by participation in refereed intercomparison exercises (as available) and repeated analyses of reference materials, calibration checks, and laboratory method blanks. Laboratories will be expected to take corrective actions promptly if measurement quality objectives described in this plan are not met.

A laboratory may be audited at any time to determine and document that they have the capability to analyze the samples and can perform the analyses in compliance with the QA plan. Independent data validation will be undertaken promptly after analyses of each sample batch to verify that measurement quality objectives are met. The data validator will discuss any unacceptable findings with the laboratory as soon as possible, and assist the laboratory in developing a satisfactory solution to the problem.

6.1 Standard Operating Procedures for Analytical Methods

Prior to the analysis of field samples, each laboratory is required to submit to the QA Coordinator for review and approval, written Standard Operating Procedures (SOPs) detailing the procedures used in sample receipt and handling, sample preparation and analysis, data reduction and reporting. Once approved, the SOPs for each analytical method and from each analytical laboratory will be archived with this plan as part of the QA documentation.

6.2 Determination of Method Detection Limit, Quantitation Range, and Reporting Limits

The analytical laboratory will establish and report a method detection limit (MDL) for each analyte of interest in each matrix, with the exception of oil for which MDLs cannot be accurately determined. The target detection ranges or limits are specified in **Tables 1.1a – 1.1e**. The actual MDLs will be established by following the method in *40CFR part 136*. Results that are less than 5X the MDL or less than the lowest calibration standard will not be required to meet the measurement quality objectives (MQOs) for precision and bias, because these results may be outside the "quantitation range". Thus, these results may be flagged by the laboratory with a J, to indicate the results are possibly an estimate and have not been required to meet the MQOs. If the analyte is not detected in a sample, the result will be reported as non-detected at the MDL and flagged with a "U".

Reporting limits for the supporting analyses (percent moisture, percent total extractable organics [TEO], total organic carbon, and grain size) will be 0.01%. The reporting limit will be demonstrated by the laboratory to be greater than 5X the detection limit.

Target detection limits, as shown at the bottom of **Tables 1.1a through 1.1e**, may not be met due to required dilutions, interferences, and/or limited sample size. If a laboratory MDL does not meet the target detection limit, the reason for the elevated detection limits should be discussed in the laboratory case narrative.

6.3 Quality Control Criteria

MQOs and required minimum frequency of analysis for each QC element or sample type are summarized in **Tables 6.1a – 6.1g**. The analytical laboratory will determine when MQOs have not been met, and perform appropriate corrective actions before continuing the analyses or reporting of the data. If the "Corrective Action" in the Method Performance Criteria table states "Resolve before proceeding", the laboratory must perform an adjustment to the analytical process and subsequently demonstrate the criteria will be met before proceeding with analysis for project samples. In addition, if results associated with a non-compliant QC element have been obtained, the laboratory must repeat those analyses until acceptable QC results are obtained. If the laboratory determines the non-compliance does not affect the quality of the data, the laboratory will discuss the non-compliance and the rationale, used to conclude the data are not affected, in the case narrative which accompanies the data report. If the laboratory determines the non-compliance is due to interferences or circumstances outside the laboratory's control, the laboratory will discuss the reason for the non-compliance in the case narrative and the results reported.

At this time, no criteria for evaluating the target analyte concentrations in the MC252 Reference Oil have been established. Chromatographic resolution criteria for specific compound (peaks) are specified in **Tables 6.1a through 6.1e** and **Table 6.1g** below. When additional criteria are developed they will be added to this Analytical QAP.

TABLE 6.1a
Method Performance Criteria for Extended PAH (Parent and Alkyl Homologs) and Related Compounds

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration (All parent PAH and selected alkyl homologue PAH)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
Matrix SRM 1941b for sediment; SRM 1974b for tissue	One per batch/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Within ±20% of NIST 95% uncertainty range for analytes within the quantitation range. 2 analytes may be greater than 20% outside, however average %D must be <35%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of 9-methylphenanthrene from 1-methylphenanthrene (m/z 192). Plus additional criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%, except biphenyl (40%-140%) and decalin (25%-125%)	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the concentration of Benzo[g,h,i]perylene to phenanthrene ≥0.70	Resolve before proceeding.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120% except d12-perylene which is 10-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1b
Method Performance Criteria for Alkanes/Isoprenoids Compounds and Total Extractable Hydrocarbons

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration (Standard solution - all target analytes, except phytane, and C_{31}, C_{33}, C_{35}, and C_{39} n-alkanes)	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 15 for 90% of analytes %D ≤ 20 for 10% of analytes	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%	Resolve before proceeding.
SRMs - no SRMs for SHC or TPH are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution >80% of n-C17 from pristane; Add'l criteria to be developed.	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Duplicate Sample Analysis (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Mass Discrimination	Initial calibration and CCVs (mid-level)	Ratio for the raw areas of n-C36 / n-C20 ≥0.70	Resolve before proceeding.
Surrogates	Every sample	%R 40-125%	Re-extract affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1c
Method Performance Criteria for VOCs

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Per SW846 8260B	Resolve before proceeding
Initial Calibration (ICAL)	Prior to every sequence, or as needed based on continuing calibration/verification check.	Minimum of 5 concentration levels %RSD ≤ 25% for 90% of analytes %RSD ≤ 35% for all analytes >C6	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25% for 90% of analytes %D ≤ 35% for all analytes >C6 Except t-butanol <50%	Perform Instrument Maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 80-120%. Except 2 analytes can be at 60 - 140%	Resolve before proceeding.
SRMs – No SRMs are available at this time			
MC 252 Reference Oil	One per batch/every 20 field samples	To Be Determined	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils)	One per batch/every 20 field samples	%R 50% - 130% for target analytes detected at >5X the spiked amount; RPD ≤30%.	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 130% for target analytes, RPD ≤30%.	Resolve before proceeding.
Procedural Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedances'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 70-130%	Re-extract or re-analyze affected samples. Evaluate impact to data, discuss with manager, determine if corrective action is needed.

TABLE 6.1d
Method Performance Criteria for Quantitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Tuning	Prior to every sequence	Tune as specified in laboratory SOP	Resolve before proceeding.
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours or every 12 field samples	%D ≤ 25 for 90% of analytes %D ≤ 35 for 10% of analytes	Perform instrument maintenance. Re-analyze affected samples.
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Biomarker concentrations are not certified; Peak resolution (*m/z* 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No more than 2 analytes to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogate	Every sample	%R 50-130%	Evaluate impact to data, discuss with manager, if corrective action is needed.

TABLE 6.1e
Method Performance Criteria for Qualitative Biomarkers

Element or Sample Type	Minimum Frequency	Measurement Quaiity Objective/ Acceptance Criteria	Corrective Action
Oil SRM 1582 (Oil and Water only)	One per batch of oil/every 20 field samples	Peak resolution (m/z 191) of: (a) oleanane (T18) from hopane (T19); (b) C26 Tricyclic Terpane stereoisomers 22R (T6b) from 22S (T6c) and from C24 Tetracyclic Terpane (T6a)	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Peak resolution (*m/z* 191): 30-Norhopane (T15) from 30-Norneohopane (T16) from Diahopane (X). Add'l. criteria To Be Determined.	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	No interference with biomarker patterns	Resolve before proceeding. QA coordinator may be contacted to resolve issues surrounding 'minor exceedance'.
Sample Duplicate	One per batch/every 20 field samples	Qualitative comparison meets laboratory SOP	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.

TABLE 6.1f
Method Performance Criteria for General/Conventional Chemistry

Conventional Sediment Parameters: Total Organic Carbon (TOC), Grain Size, Total Solids
Tissues: Total Extractable Organics (TEO)

QC Element or Sample Type	Minimum Frequency	Acceptance Criteria	Relevant Parameter(s) Reference Methods*
Initial Calibration	Prior to analysis (method and instrument specific procedures & number of standards)	For multipoint calibration, Correlation coefficient (r) >0.995	TOC
Continuing Calibration	Must start and end analytical sequence and every 10 samples	%R 90%-110%	TOC
Method Blanks	One per batch/every 20 field samples	Not to exceed QL	TOC, TEO
Blank Spike Samples	One per batch/every 20 field samples	%R 75% - 125%	TOC
Matrix Spike Samples	One per batch/every 20 field samples	%R 75% - 125% If MS/MSD analyzed, RPD ≤ 25%	TOC
Replicate Analyses[13]	Each sample must be analyzed at least in duplicate. The average of the replicates shall be reported.	RPD or %RSD < 20% for concentrations > QL	TOC
Sample Duplicates[14]	One per batch/every 20 field samples	RPD ≤ 25% for analyte concentrations greater than QL	TOC, Grain Size, TS, TEO
Reference Materials TOC NIST 1941B TEO NIST 1974B	One per batch/every 20 field samples	Values must be within ±20% of NIST uncertainty range	TOC, TEO

* Reference Methods

TOC	Plumb 1981/SW 846 Method 9060A
Grain Size	ASTM D422. If using sieve analysis only, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. If using sieve and hydrometer, report as percent gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay.
TS (percent)	EPA 160.3

Method 9000 series - analytical methods from SW-846 (U.S. EPA 1986) and updates
The SW-846 and updates are available from the web site at: http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm
Plumb (1981) - U.S. EPA/U.S. Army Corps of Engineers Technical Report EPA/CE-81-1 :
http://yosemite.epa.gov/r10/CLEANUP.NSF/ph/T4%20Technical%20Documents/$FILE/Plumb.pdf

[13] Method SW9060 requires quadruplicate analyses, however duplicate or triplicate analyses are acceptable.

[14] Method SW9060 requires a duplicate spike. A matrix spike and sample duplicate are acceptable in lieu of matrix spike/matrix spike duplicates. For grain size, RPD criteria only applied if fraction is greater than 5%.

TABLE 6.1g
Draft Method Performance Criteria for Analysis of Dioctylsulfosuccinate sodium salt (DOSS)

Element or Sample Type	Minimum Frequency	Measurement Quality Objective/ Acceptance Criteria	Corrective Action
Initial Calibration	Prior to every sequence, or as needed based on continuing calibration/verification check.	5-point calibration curve over two orders of magnitude %RSD ≤ 20	Resolve before proceeding.
Continuing Calibration (CCAL)	Every 12 hours	%D ≤ 30	Perform instrument maintenance. Re-analyze affected samples.
Initial Calibration Verification (Second Source or can be met if CCAL is second source)	Per initial calibration	%R target analytes 70-130%	Resolve before proceeding.
MC 252 Reference Oil	One per batch/every 20 field samples	Criteria to be developed	Resolve before proceeding.
Matrix Spike/Matrix Spike Duplicate (Sediments, Soils, Tissues only)	One per batch/every 20 field samples	%R 50% - 125% if sample concentration detected at >5X the spiked amount; RPD ≤30%	Evaluate impact to data, discuss with manager, determine if corrective action is needed.
Blank Spike/Blank Spike Duplicate (Aqueous Samples)	One per batch/every 20 field samples	%R 50% - 125; RPD ≤30%	Resolve before proceeding.
Method Blank	One per batch/every 20 field samples	Not to exceed 5x target MDL unless analyte not detected in associated samples(s) or analyte concentration >10x blank value	Resolve before proceeding.
Sample Duplicate (not required for water matrix)	One per batch/every 20 field samples	RPD ≤ 30% if analyte concentration is greater than QL	Evaluate impact to data, discuss with manager, and determine if corrective action is needed.
Internal Standard (IS)	Every sample	50% - 200% of the area of the IS in the associated calibration standard	Resolve before proceeding.
Surrogates	Every sample	%R 40-120%	Re-extract affected samples. Evaluate impact to data, discuss with manager, if corrective action is needed.

6.3.1 Initial Calibration

Acceptable calibration (initial and continuing) must be established and documented before sample analyses may begin. NIST-traceable calibration materials must be used where available in establishing calibration. Initial calibrations will be established according to the criteria in **Tables 6.1a – 6.1d , 6.1f and 6.1g**. A specific requirement for this project is to use methodology (and tune instrumentation) for low detection limits, therefore, samples with analytes above the calibration range will be diluted and reanalyzed. If samples require a dilution, results from the initial analytical run that were within the calibration range should be reported. Results from the diluted analyses should be reported for only those analytes which exceeded the calibration. .

6.3.2 Continuing Calibration Verification

Continuing calibration verification (CCV) standards will be run at the frequencies indicated in **Tables 6.1a – 6.1d, 6.1f and 6.1g**. If CCV results do not meet the specified criteria, then the instrument must be re-calibrated and all samples analyzed since the last acceptable CCV must be re-analyzed.

6.3.3 Reference Materials

Reference materials of a matrix appropriate to the samples being analyzed, will be analyzed every 20 samples throughout the analytical program, if available. The data resulting from the analysis of these samples will be reported in the same manner as that from the field samples. These data will be the prime materials used to determine and document the accuracy and precision of the associated field sample data. The reference materials to be used are listed in the criteria tables.

Accuracy is computed by comparing the laboratory's value for each analyte against either end of the range of values reported by the certifying agency. The laboratory's value must be within 20% of either the upper or lower end of NIST's 95% uncertainty range. For oil, water, filters, and inert sorbent materials analyses, the SRM is not extracted, but analyzed only on the instrument. The MC252 Reference Oil will be run with each batch of samples (e.g., GU2988-A0521-O9805 or equivalent as approved by the QA Coordinator). Chromatographic resolution criteria of selected peak pairs in the Reference Oil are indicated in **Tables 6.1a-6.1e**. After initial data sets are acquired, additional criteria for the Reference Oil will be determined.

6.3.4 Method Blanks

Method blanks are laboratory derived samples which have been subjected to the same preparation or extraction procedures and analytical protocols as project samples. A method blank will be analyzed with every 20 field samples analyzed. Acceptance criteria are provided in **Tables 6.1a – 6.1g**. Failure to meet acceptance criteria requires definitive corrective action to identify and eliminate the source(s) of contamination before the subsequent reanalysis and re-extraction of the blank and affected samples. Sample results will not be blank corrected.

6.3.5 Sample Duplicates

A duplicate sample aliquot from a representative matrix will be prepared and analyzed with every 20 field samples, except for water samples, filters, and inert sorbent materials for SHC/TEH and PAH. Water samples, filters and inert sorbent materials for SHC/TEH and PAH will not be analyzed in

duplicate because of the difficulty in subsampling representative aliquots. If duplicate VOA vials are collected, then volatile organic analyses may be performed in duplicate. Acceptance criteria the other matrices are provided in **Tables 6.1a – 6.1g**.

6.3.6 Matrix Spike/Matrix Spike Duplicates or Blank Spike/Blank Spike Duplicate

Matrix spike/matrix spike duplicates (MS/MSDs) will be analyzed every 20 samples, except for water samples, filters and inert sorbent materials. MS/MSDs will not be analyzed with the water sample batches because of the difficulty in subsampling representative aliquots from a sample container. Instead, blank spike/blank spike duplicates (BS/BSDs) will be analyzed with each batch of water samples. Samples will be spiked prior to extraction. Spike solution concentrations for the MS must be appropriate to the matrix and anticipated range of contaminants in the sample; that is 2 to 10 times analyte concentration. However, because it is not possible to know the concentration of contaminants prior to analysis, professional judgment may be exercised in choosing concentrations that are reasonable under the circumstances.

6.3.7 Internal Standards

All samples will be spiked with internal standards prior to analysis, when required by the analytical method. Control criteria for internal standard recovery are listed in **Tables 6.1a – 6.1d, and 6.1g**.

7.0 DATA REDUCTION, VALIDATION AND REPORTING

7.1 Data Reduction

Data reduction is the process whereby raw data (analytical measurements) are converted or reduced into meaningful results (analyte concentrations). This process may be either manual or electronic. Primary data reduction requires accounting for specific sample preparations, sample volume (or weight) analyzed, and any concentrations or dilutions required.

Primary data reduction is the responsibility of the analyst conducting the analytical measurement and is subject to further review by laboratory staff, the Laboratory Project Manager and finally, independent reviewers. All data reduction procedures will be described in the laboratory SOPs. Any deviations from the laboratory SOPs will be discussed in the laboratory case narratives.

- Concentrations will be reported as if three figures were significant.
- Data generated from the analysis of blank samples will not be utilized for correction of analyte data.
- Surrogate compounds, matrix spikes, and spike blanks will be evaluated as %R.
- Reference materials will be reported in units indicated on the certificate of analysis.
- Continuing calibration factors will be presented as %D
- Duplicate sample results will be expressed as RPD.

7.2 Data Review and Validation

Data review is an internal review process where data are reviewed and evaluated by personnel within the laboratory. Data validation is an independent review process conducted by personnel not associated with data collection and generation activities.

Data review is initiated at the bench level by the analyst, who is responsible for ensuring that the analytical data are correct and complete, the appropriate SOPs have been followed, and the QC results are within the acceptable limits. The Laboratory Project Manager has final review authority. It is the Laboratory Project Manager's responsibility to ensure that all analyses performed by that laboratory are correct, complete, and meet project data quality objectives.

External and independent data validation will be performed for all samples by the QA Contractor using a full data package containing sufficient information to allow the independent validation of the sample identity and integrity, the laboratory measurement system, and resulting quantitative and qualitative data. The required information with associated instrument print-outs are listed in **Table 7.1**.

TABLE 7.1 Laboratory Data Deliverables Per Sample Batch

Chain-of-Custody/ Sample Receipt Checklist	
Sample Data:	Result summaries including surrogate recoveries, percent total solids, dilutions, etc
Standards Data:	Target MDL data based on the method in *40 CFR, 136* Calibration summaries: Initial calibration data, standard curve equation, correlation coefficient or %RSD, continuing calibration %D.
Quality Control Data (Method Blanks, CRMs, Duplicates, Matrix Spikes, Spike Blanks):	Results summaries including surrogate recoveries, plus %R and RPD, as applicable.
Case Narrative:	Special handling or analysis conditions. Any circumstance that requires special explanation such as an exception to QA/QC conditions or control criteria, dilutions, reanalysis, etc. Corrective actions/procedure alterations
Chromatograms and Extracted Ion Profiles	Appropriately scaled (1) GC/FID chromatograms for samples and associated QC analyzed for extractable hydrocarbons; (2) GC/MS EIPs for samples and associated QC analyzed for qualitative biomarkers
Electronic Data Deliverable:	As specified in laboratory contract.

Three levels of data validation will be performed (see USEPA, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. EPA-540-R-08-005. January 2009 for definitions): full (stage 4), summary (stage 2B), or cursory (stage 2A) validation. Full validation will consist of a review of the entire data package for compliance with documentation and quality control criteria for all the following items, plus recalculations of instrument calibration curves, sample and QC results. Summary validation will consist of a review of all the following items, but without recalculations. Cursory validation will consist of a review of only the starred (*) items:

- Package completeness*
- Holding times from extraction to analysis*
- Instrument calibration, initial and continuing
- Blank results*
- Instrument performance
- Spike recoveries*
- Standard reference material results*
- Laboratory duplicate results*
- Reported detection limits*
- Compound quantitation
- Compound identification
- Verification of electronic data deliverable (EDD) against hardcopy (10% verification)*

As the project proceeds and the quality of the data is verified and documented, the level of validation will decrease at the discretion of the QA Coordinator. At a minimum, cursory validation will be performed on all data packages, i.e., only the starred items will be reviewed.

Qualifiers (**Table 7.2**) may be assigned to individual data points by the QA Contractor. These validation qualifiers will not replace qualifiers or footnotes provided by the laboratory, but will be added to the data summary tables to inform the data user whether or not the data met all project quality objectives. Both sets of qualifiers will be maintained in the database.

TABLE 7.2 Data Validation Qualifier Codes

U	Analyte concentration is not significantly greater than the associated blank result. The result is judged to be the detection limit.
R	Unreliable result. Data should not be used.
N	The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.
J	Reported concentration is an estimate with potentially more bias, or less precision than an unqualified concentration, as judged by associated calibration and/or reference material results.
UJ	Not detected. Detection limit is an estimate with potentially more bias or less precision than an unqualified detection limit as judged by the associated quality control results
DNR	Do not report; A more appropriate result is reported from another analysis or dilution.
F	Found. Analyte detected at less than the MDL, however, peak height is greater than 3 times the noise level and ID criteria are met.

All discrepancies and requests for additional corrected data will be discussed with the laboratory prior to issuing the formal data validation report. Review procedures and findings during data validation will be documented on worksheets. A validation report will be prepared for each data group/data package summarizing QC results, qualifiers, and possible data limitations. Only validated data with appropriate qualifiers will be released for general use. Data are not considered final until QA Coordinator has performed assessment and accepted the data.

In addition, the validated data will be reviewed by the QA Reviewer on behalf of BP America. The following process shall be used should the independent validation of the laboratory data results in a material difference in how qualifiers have been assigned or in the actual value itself:

- The QA Coordinator and QA Reviewer will meet to determine the source of the difference, and resolve. No changes to validated results will be made if the differences are considered immaterial to both the QA Coordinator and QA Reviewer.
- If the validated data have already been released by the QA Coordinator, then the data will be updated in accordance with the resolution and reposted.
- Should there be no agreement on how to resolve the difference, the QA Coordinator and QA Reviewer shall request further assistance from the Assessment Managers and BP America, respectively.
- The basis for all material changes to validated results will be documented along with the resubmitted validated data.

8.0 CORRECTIVE ACTION AND PROCEDURE ALTERATION

The analytical laboratories are required to adhere to the SOPs submitted by them to the QA Coordinator for this project. When the data from the analyses of any quality control sample exceeds the project specified control limits or indicates that the analytical method is drifting out of control, it is the

immediate responsibility of the analyst to identify and correct the situation before continuing with sample analysis.

A narrative describing the problem noted, the steps taken to identify and correct the problem and the treatment of the relevant sample batches must be prepared and submitted with the relevant data package. If the action indicates a revision to the accepted SOP is warranted, the laboratory will revise the SOP and resubmit the SOP to the QA Coordinator within 30 working days after the problem was noted. Until the revised SOP is approved, any data sets reported with the revised method will have the any changes to the method noted in the laboratory's case narrative.

9.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance/Quality Control (QA/QC) reports will be submitted periodically to the Assessment Manager(s) by the QA Coordinator. These reports may be either formal or informal in response to the Assessment Manager's request. Upon termination of the analytical work for this damage assessment, a formal QA report will be submitted. This report will include:

- General compliance with QA objectives
- Summary of technical and performance evaluation audits
- Summary of data validation reports
- Summary of laboratory control charts

10.0 REFERENCES

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USEPA, 2002. *Guidance for Quality Assurance Project Plans*, (EPA QA/G-5) EPA/240/R-02/009, December 2002. http://www.epa.gov/quality/qs-docs/r5-final.pdf

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Quality Assurance Guidelines for NRDA Water Column Chemistry

Purpose

This document provides general guidance for field sampling data quality assurance for the collection of NRDA field samples for planned sampling cruise to assist in the validation of 3-dimensional modeling of subsurface plume structure.

The current sampling plan involves sampling multiple depths at numerous stations directed by Dr. D. French-McCay (based on measured currents, SIMAP modeling, and input from the Subsurface Monitoring Unit (SMU)) for BTEX, THC, PAHs and free oil droplet size. Sampling requirements as outlined for basic sampling to address field program objectives for adequate description of locations are presented in Table 1. This sampling scheme is derived from the Field Plan and Sampling Protocol documents.

Table 1: Required Analytical Samples for 3-dimensional modeling data support

Sample Type	Volume Needed	**Minimum** # of samples per location
BTEX	40 mL	2 per depth
THC and PAH	1 gallon	1 per depth
Oil Droplet distribution	10 mL	10 per sample depth

In addition to basic site description, additional sampling requirements for data verification and validation, as well as equipment and procedural validation are required. These samples and the suggested frequency are described below.

Laboratory Notebook

All errata and observations that do not have a logical spot on the Chain of Custody form shall be documented in a bound lab notebook with numbered pages. Additional notation shall be written in black or blue ink. Entry errors shall be crossed out with a single line, initialed, and dated.

Blank Samples

Laboratory Grade de-ionized (DI) water in certified clean glass containers will be provided by Pace Laboratories. Sampling blanks shall be collected, where practical, using the laboratory provided water, according to the described methodology for BTEX and THC/PAH analyses (including filtration) at each sample location. These samples shall be handled and stored in accordance with the accepted methodology for each sample type. At stations where two DI samples are collected, one shall be collected before Go-Flo bottle sample collection, and one shall be collected after the last seawater sample is collected.

Storage Procedure Monitoring
Aqueous samples shall be refrigerated to 4 °C (+/- 0.5 °C). DO NOT FREEZE. Refrigeration temperature shall be recorded when samples are stored, and periodically monitored and recorded to ensure proper refrigeration. A thermometer will be available to remain with the aqueous samples in storage for monitoring purposes.

Filter samples shall be frozen for storage. Storage temperature shall be kept at 0 °C or below. Refrigeration temperature shall be recorded when samples are stored, and periodically monitored and recorded to ensure proper refrigeration. A thermometer will be available to remain with the filter samples in storage for monitoring purposes.

Methods for sample replicates/splits
To accomplish random sample splits, two methods can be employed during the cruise. Method One will be simultaneous deployment of two 5 L (or similar size) Go-Flo bottles which will be closed at the same depth in order to collect sample water as similar as practical. Method Two involves deploying a single 10 L Go-Flo bottle (if available) and collecting samples in series from the same bottle upon retrieval. Method One will be the preferred method. Method choice must be documented on the Chain of Custody form as **Replicate** (Method One) or **Split** (Method Two).

Sampling Equipment Monitoring
All tubing used with the PLVWSS shall be visually inspected before sampling. Sampling tubing shall be changed when contamination is visually obvious. Tubing changes shall be documented in a separate laboratory notebook (date, time, location).

Sample Depth Determination and Verification
Sample depths shall be chosen to best elucidate modeling data needs. For all samples (except ROV collected samples where depth is dependent on visual observations of TV feed to facilitate collection of observed dispersed oil droplets in the water column), depths for Go-Flow samplers must be preset (based on CTD and fluorometry data) and the depth selections recorded. Verification of triggering sequence of the CTD shall be made and documented in order to verify samples were collected as expected. Go-Flo bottles shall be numbered and numbers documented with sample station and on Chain of Custody forms. Any malfunction of the triggering of the Go-Flo bottle operation shall be documented.

NRDA Field Sampler Data Management Protocol

10-22-2010

MS Canyon 252 (Deepwater Horizon) Oil Spill

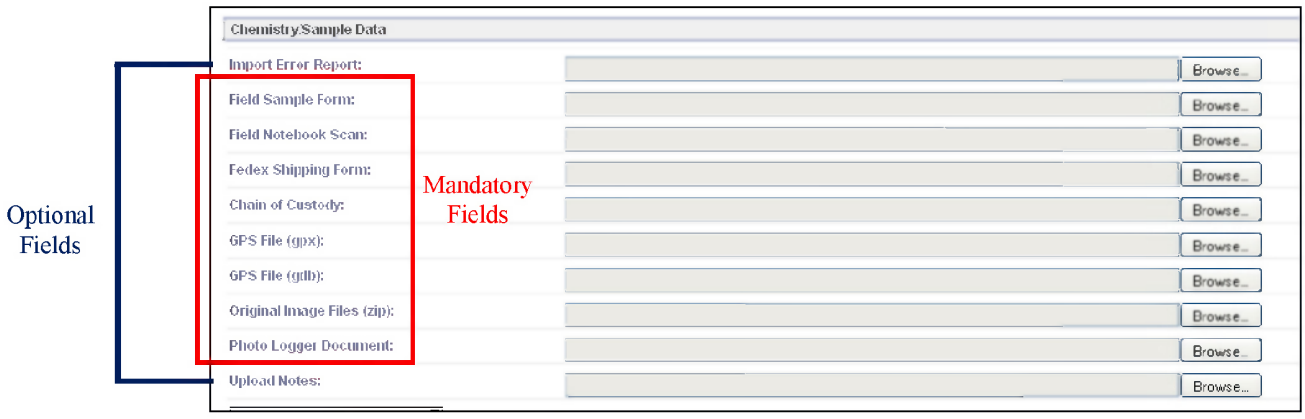
NOTE: THESE INSTRUCTIONS REPLACE ALL PREVIOUS INSTRUCTIONS.

These instructions update the protocol for preparing field sample records and uploading field sampling data into NOAA's NRDA Content Management System (www.noaanrda.org) and match the sampling forms version 16.2.1 updated in July 2010. NRDA samples submitted for chemistry must comply with the documentation requirements set forth in the NOAA field sampling form documentation and outlined below. Samples that do not meet these requirements will not be processed by the laboratory. Individuals who submit samples that do not comply with documentation requirements will be instructed on proper procedures and be given the opportunity to correct any deficiencies; however, this will delay data acquisition. This system was developed with both legal and scientific considerations. Prior to undertaking any sampling, please familiarize yourself with all of the required data elements on the forms relevant to your effort. These documentation requirements are relevant to all work groups, with the exception of the sub-surface multi-depth water sampling conducted on research cruises, which is subject to its own documentation requirements (see Cruise Data Protocol document).

A weekly Q&A session for field samplers (Wednesday at 4pm CDT) goes through the contents of this protocol. Please join the webinar if you are new to NRDA Field Sampling or if you have questions about field sampling protocol. The number to call in to the webinar is 866-763-3375 and the Participant Code is 9557764, and the webinar is presented at https://www1.gotomeeting.com/join/454999441

NRDA Sample Data Requirements

All analytical sample data must be submitted through the NOAA NRDA Content Management System. A complete file collection must include those listed as Mandatory in the graphic below. In the event that all Mandatory files are not uploaded, the sampling event will not be included the database and you will be notified by a representative from the NRDA Data Management team. The only optional fields include Import Error Report and Upload Notes.



To gain access to the NOAA NRDA Content Management Site, users must request access via support@noaanrda.org or call (866) 974-0614. Each component of a complete file collection is discussed below.

Field Sample Documentation

The NRDA Field Sample Form and related guidance documents are located on the NOAA NRDA site (*Documents* > *Field Sample Form*). When a sample is collected for chemical analysis, the following documentation is required and must be provided in order for the samples to be accepted for analysis:

- **Sample collection information**: **All** fields on the applicable NRDA Sample Collection Form (Oil-Tarball-Water, Soil-Sediment, or Tissue-Wrack) must be filled out, with the exception of those fields noted below. There are three options to record this required information:
    a. Use the matrix-specific NRDA Sample Collection Forms;
    b. Record **all** the required information on paper (e.g, other form, log book); or
    c. Record **all** the required information directly into a spreadsheet.
- **NRDA Chain of Custody (CoC) Form**: Complete all fields in the COC form with the exception of the fields noted below. NOTE: Written documentation must be in the NRDA format for this project.
- **Field log books:** If a log book is used, either the log book must be submitted for scanning or appropriate scanned pages must be delivered with the samples. Originals may be demanded in the future; they must be kept by your agency or turned in to the SIC or other NOAA representative.

All data fields on the forms are to be ***completely*** filled out. Exceptions to the data field requirements are very limited:

- NRDA CoC form
    - Analyses Requested (if uncertain, select "As per sample plan" in picklist)
    - Lab Name (if unknown, please write "Lab")
    - Waybill Number (Laboratory will fill in if coolers are sealed prior to obtaining waybill number)
    - Turn Around Time
- NRDA Sample Collection Forms
    - Resource Group Leader (Preferred, but not legally required)
    - Chain of Custody Field CoC information (Only if an intermediary delivers samples from sample site to SIC)
    - Notes sections (The notes sections are not mandatory; however samplers are encouraged to use these sections to provide additional detail.

Pre-Field Sampling Protocol

I. Before going into the field for the first time, the NRDA field sampler should watch the sample training videos and review the Field Form User Guide (Documentation > Sampling Training Session). Any outstanding questions can be addressed via email (dwhnrda@gmail.com), the **Field Sample Form helpline at (985) 746-1394**, or through attending the weekly Q&A session. This explains the official NOAA NRDA field sampling form.

II. Before going into the field *each day*, the NRDA field samplers should generally complete two tasks.

1. Print necessary field sampling forms (*Documentation > Field Sampling Form*).

2. Determine your NRDA Sampling Grid Location Code (*Documentation > NRDA Grid Location Code Maps*).

Near-Shore/Land Sampling:
a. Choose the index map for the state in which you will be sampling.
b. Find the sampling grid map corresponding to the specific area in which you will be working.
(*Documentation > NRDA Grid Location Code Maps*)

c. Use the sampling grid map to find the grid in which you will be working. The codes are noted in the center of each cell.

Water-Based Sampling:
Given the extent of the Gulf activities, for open water-based sampling please use the following convention:
- GU (for Gulf of Mexico) or EC (for East Coast, east of the Florida Keys)
- Degree Latitude
- Degree Longitude

For example, in the Gulf of Mexico sampling location 27.30 North and -88.30 West code would be GU2788.

Sample Collection Information Options

With every chemistry sampling event, the information on both the matrix-specific NRDA Sample Collection Forms and the NRDA Chain of Custody Form must be collected. For legal defensibility, original copies of all documents must be retained. Individual agencies may choose to retain custody of these documents (field forms, log books) and

provide only electronic copies to NOAA; in this case, the individual agency is responsible for providing the material in the event of a discovery request. Alternatively, the original documents may be signed over to NOAA and its contractors, and will be retained in secure document storage.

Some sampling teams may find it convenient or necessary to use formats besides the NRDA Sampling Collection Form to capture this information. There are three options to record this information. If you do multiple days of sampling, you need to fill out one electronic field form per day.

1. ***Use the NRDA Sample Collection Form for the specific matrix you are working with*** (strongly recommended option). The three NRDA Sample Collection Forms are:
   - Oil/Tarball/Water (use separate forms to track water versus oil/tarball)
   - Tissue/Wrack
   - Soil/Sediment

   The completed original NRDA Sample Collection Form is turned in with the samples when using a Sample Intake Center (SIC). If the sampling team is not using a SIC, the data from this form are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded to the NOAA NRDA site with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy via a traceable carrier (e.g. U.S. registered mail, FedEx, UPS or similar) to the NRDA document manager:

   NRDA Document Manager
   c/o Industrial Economics
   2067 Massachusetts Avenue
   Cambridge, MA 02140

2. ***Use a form other than the NRDA Sample Collection Form for recording the required information.*** The information can be recorded on another form or in a field log book. It is imperative that **all** required fields from the NRDA Sample Collection Form be recorded (see above requirements). When using a form other than the NRDA Sample Collection Form, the original form or field log book must be turned into the SIC. If the sampling team is not using a SIC, the data from the form or field log book are entered electronically into either the MS Excel-based Field Sample Workbook or Flat File forms and uploaded to the NOAA NRDA site. Copies of the hand-written form must be scanned and uploaded with the data spreadsheet. Originals may be retained by individual agencies or submitted in hard-copy to the NRDA document manager (see address above).

3. ***Use a computer to input the information directly into a spreadsheet.*** The required information from the NRDA Sample Collection Form can be recorded directly into a computer provided the following steps are followed:
   a. The computer file is recorded on a CD/DVD (non-rewritable) at the end of each field day.
   b. The following is recorded on the CD/DVD label:
      i. Name of person entering data into the computer system
      ii. Date of sample collection/data input
      iii. Make and serial number of the computer
      iv. Software used and version number
   c. A NRDA Chain of Custody is completed for transfer of the CD/DVD
   d. The files on the CD/DVD are uploaded to the NOAA NRDA website.

   The original file is kept on the computer system until it is verified that the CD/DVD recorded properly. This CD/DVD is turned in with the samples if using a SIC. If the sampling team is not using a SIC, this CD/DVD must be sent to the NRDA document manager under chain of custody (i.e., with a CoC form and using a secure carrier such as FedEx).

If you have questions or need assistance with the workbook please first look for the answer in the User Guide, then try to attend the weekly webinar. If you cannot attend the webinar, you may call the field sampling form/COC **helpline number at (985) 746-1394**. Again, general questions regarding the forms may posted to NRDA Gmail address (dwhnrda@gmail.com): inquiries are usually responded to within 24 hours.

Regardless of which reporting approach you choose, name the file using the following naming convention. The date is the **date sampled** (if multiple sampling days *on cruises only*, use the last day of samples).

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>.xls

For example:
2010_0701_SMITH_JOHN_FieldSampleForm.xls

Scanning Field Form Documents

Scans of all paper forms used in the field and any log book entries must be included in the file collection upload. All sample intake centers have scanners.

Chain of Custody (COC) Forms and Mailing Labels

Please scan your ***signed*** COC forms and mailing labels. Note that the NOAA Spreadsheet will create a custom COC form based on your inputs. NOAA NRDA samples require the use of the NOAA NRDA COC.

Photos and GPS

Photos are taken in the field for two primary reasons: to validate the field sampling effort and to provide a visual description of field conditions and operations. The GPS is required to geo-locate the photos to a particular time and place for legal reasons. Samples will be accepted without photo documentation, but any submitted photos must follow the NRDA documentation requirements.

Pre-Field Photo/GPS Protocol

I. Read through the field photo validation documents located on NOAA NRDA (*Documentation > Photos and GPS*) which include: NRDA Field Photography Guidance, Basic GPS Skills and Garmin MapSource

II. Make sure digital camera has charged batteries, is set to a high resolution, and uses JPEG file format (not RAW).

III. Set the camera to local time and date; the time should be in 24h military time.

IV. Have a back up of all past information, and clear camera and GPS before each sampling day.

V. Set the GPS to Datum - WGS 1984, 24h military time with the correct time and date, set the track log to "wrap when full", and make sure the GPS is set in decimal degrees. The batteries for the GPS should also be fully charged.

Field Photo and GPS Protocol

I. Turn on your GPS. Leave it on for the entire sampling day.

II. Take one photo of your GPS screen which displays the time (including seconds) and date clearly. Make sure the GPS screen is clear in the photo. This will be used with the GPS track log to geo-locate the photos.

III. Take photos of the field samples and sampling effort. Remember, for legal reasons, do not delete or rename photos.

Post-Field Photo and GPS Protocol

I. Download your photos from that day's sampling only. Place them in a folder called Photos to be included in the zip file. Do not open, delete or rename any of the photos. If you wish to view your photos, you may download them again to your own personal folder and view them. Sample Intake Centers can also upload your photos.

II. Download the GPS Track Log and way points using Garmin MapSource. Save the points twice from MapSource: once as a Garmin Database file (.gdb) and once as a GPS exchange file (.gpx). If you have other non-Garmin GPS/latitude longitude information, please provide GPS locations in a format (e.g., excel) that links the photo name with its coordinates. If the field locations are staffed with members of the data management team, they can assist you with this process.

III. Fill out the NRDA Photo Logger form. This is required and located on NOAA NRDA *(Documentation > Photos and GPS*). Without the form, the data management team will not be able to log your photos.

Uploading the File Collection to the NOAA NRDA Website

Naming Convention for Uploaded Files

Naming files in a consistent way will greatly speed up the processing of the sampling information. Please use the following naming convention (the date field representing the sample date):

<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>>_<<FILE_TYPE>>

For example:
2010_0505_SMITH_JOHN_PhotologgerForm.PDF

Uploading Sample Information and Notifying Data Management

To upload all associated with a sample and/or observation event, go to the NOAA NRDA site at: www.noaanrda.org

On the left-hand navigation columns, click on "Data Entry/Data Exports" under the **Access/Post Data** heading. From here, users will notice a link to the Uploading Tool. Under the **Workgroup:** dropdown menu, choose "-All Sample Data/Chemistry" and click on the **Upload** control button in the upper right-hand corner. This will navigate the user to the actual page for file collection uploads.

Choose the Workgroup and Workplan related to your sample team (if you do not know this, contact your Technical Workgroup lead). From here you will be asked whether observational data was also collected during the sampling event. If you have observational data, you will be prompted to enter this information in a portion of the NOAA NRDA site dedicated to observation data (from there, users can also upload sample data). Otherwise, if a user does not have observational data, a series of data entry prompts will appear. This includes prompts to enter general information about the sampling event and places to upload specific files. Note that the NOAA NRDA site currently has a limit of 1 GB *per file.* If you have files that are larger than 1 GB, please split into multiple files, label appropriately, and enter in the additional files using the dropdown that the bottom of the Sample/Chemistry Data section. Here, users can specify the type of auxiliary document associated with the file collection.

Also, please do not scan documents at a resolution higher than 300 DPI. This will help keep file size down.

*******IMPORTANT*******

Once you have uploaded the file collection to NOAA NRDA, you must alert the data management staff. Please send an email to the Gmail account (dwhnrda@gmail.com) as notification. Specifically, please use the following subject heading: SAMPLE TO NOAA NRDA<<YYYY>>_<<MMDD>>_<<LAST NAME>>_<<FIRST_NAME>> For example: SAMPLE TO NOAA NRDA 2010_0505_SMITH_JOHN

Once again, thank you very much for following these procedures. Assistance from all sampling teams will improve efficiency and reduce our need to call you back for missing information.

SUBJECT: Safety Plan

PREPARED FOR: NRDA (Natural Resources Damage Assessment) Field Operations

REVISION: December 8, 2010

1. INTENT

1.1. The intent of this Field Safety Plan is to establish a structured process and disciplined approach to the mitigation of health, safety and environmental risks associated with our operations and activities. This safety plan applies to the Natural Resources Damage Assessment (NRDA) Team. This plan does not apply under the following situations:

- When water and air temperatures are both below 50 degrees Fahrenheit
- In air temperatures below 38 degrees Fahrenheit
- During small craft advisories
- When wind speeds exceed 25 knots
- Operations during dusk/evening
- In bad visibility and bad weather
- Offshore operations

If it is deemed necessary for operations to continue in any of the conditions outlined above, a separate job hazard evaluation must be approved and authorized by the NRDA On-Site Lead, BP-Cardno Entrix, applicable trustee representatives, the NRDA Safety Officer and NRDA Field Operations.

2. COMMUNICATIONS

2.1. A central responsible person not in the field should be aware of the daily plan, work locations, and team members for each team.

2.2. NRDA Field Teams will contact NRDA Operations (located at ICP New Orleans) as identified below to help ensure personnel accountability. Human Use field teams will report to Stratus Headquarters in Boulder, CO.

2.2.1. Departing for daily op area.

2.2.2. Mid day.

2.2.3. Termination of operations (e.g. transition to over-the-road vehicle and/or arrival place of lodging).

2.2.4. As soon as practical to report any health, safety, security, or environmental incident.

2.2.5. Using the 700mhz Radio and/or one of the following NRDA Ops contact numbers:

2.2.5.1. PRIMARY - NRDA Field Ops 504-303-2086/504-335-0863

2.2.5.2. SECONDARY – NRDA On-Site Lead 985-291-5186 (cell); noaa.mc252.nrdacoord@noaa.gov

2.2.5.3. For non-routine issues and the two above numbers can not be reached, CALL Nir Barnea (NOAA Safety) - 206-369-5015 [nir.barnea@noaa.gov] or Troy Baker (ARD SE Regional Manager) – 225 -326-9765 [troy.baker@noaa.gov].

2.3. NRDA Team Members at ICP New Orleans will update the Field Teams Status Display upon notification from a NRDA Field Team.

2.4. Each NRDA Field Team will be provided with a copy of this safety plan

3. MINIMUM EQUIPMENT/RESOURCES FOR NEARSHORE AND SHORE-BASED OPERATIONS

3.1. One primary form of communication directly to the non-field responsible person (i.e. Cell Phone, 700/800 MHz Radio, or equivalent).

3.2. Secondary form of communication capable of directly reaching rescue personal in case of an emergency (i.e. Cell Phone or Marine VHF, etc.)

3.3. Marine VHF is required for all vessel-based operations. All vessels must have a fixed mount (not handheld)VHF Marine radio on board. Handheld GPS

3.4. First Aid Kit

3.5. Foul Weather Gear (rain jacket/pants)

3.6. PFD, Float Coat, and/or Immersion Suit as appropriate to Job Hazard Analysis

3.7. Cold Weather Kit (Dry Bag, Emergency Blanket, Warm Blanket, Dry Cloths, and Hand/Feet Warmers)

4. VEHICLE SAFETY

4.1. Pre-Trip Plan (Maps, directions)

4.2. Seat Belt use is mandatory

4.3. Observe posted safety notifications and speed limits.

4.4. DRIVER - Cell phone use both hand-held and hands-free, texting, and e-mailing is prohibited while driving. If necessary, park in a safe location (off the road) and use while parked.

5. ACCIDENTS – INJURIES – SPILLS – NEAR MISSES

5.1. Accidents and injuries should first be reported to an entity that can provide emergency assistance, if needed (USCG, 911, etc.)

5.2. Accidents, injuries, spills or near misses should then be reported to NRDA Field Ops within 15 minutes.

5.3. As soon as practical (but generally within 1 hour) accidents, injuries, spills or near misses must be reported by the NRDA Field Ops to the NRDA On-Site Lead. Required documentation will be managed by the NRDA On-Site Lead with assistance by involved personnel. The NRDA On-Site Lead will notify appropriate Incident

Management Team personnel including the BP Safety Officer at the Incident Command Post.

5.4. The NRDA On-Site Lead will report accidents, injuries, spills, or near misses to the all relevant federal, state, contractor, and BP/Entrix managers by email as soon as practicable following the incident.

6. TRAINING

6.1. Any member of a NRDA Field Team is required to have the following Safety Training.

- Level I and II BP Safety Induction
- HAZWOPER Certification
- PHI Helicopter Pre-Flight Safety Briefing (if flying in helicopters)
- Heat stress and cold stress training/awareness

7. PERSONAL PROTECTIVE EQUIPMENT

7.1. NRDA Field Team members are expected to utilize Personal Protective Equipment for the activity being performed. A task requiring PPE shall not be performed unless PPE is used (refer to the Job Hazard Analysis incorporated with this document).

7.2. Staff must adhere to and follow pilot/captain/operators safety related instructions at all times. The NRDA On-Site Lead is responsible for directing team activities and will help decide if safety issues preclude scheduled activities. All team members are responsible for individual and collective safety.

8. PRE OPERATION MEETING (Tail Gate Meeting)

A daily pre-operations meeting will be conducted on-site with each team by the field team leader. Job Hazard Analysis' are located below. Specific topics of discussion will include:

- Lessons learned from the prior day's mission or other missions
- Current weather and short-term forecast
- PPE requirements
- Communications / Notification Requirements
- Food and Water
- Location of nearest treatment facility or hospital
- Potential hazards to watch out for
- Overall situational awareness

9. JOB HAZARD ANALYSIS (see following pages)

- Shore Operations
- Small Boat / Air Boat Operations
- Helicopter Operations
- Fixed Wing Operations for biological aerial surveys

- Fencing/Station marking operations
- Pom-pom inspections
- Chain drags
- Oyster sample collection
- Water quality testing
- Sampling in Phragmites
- Marine-based operations in cold weather

10. DWH NRDA SAFETY, COMMUNICATION, AND ACCOUNTABILITY CHECKLIST

Technical Working Group:_____ State:_____

Field Activity:_____

Number of Teams:_____ Persons p/Team:_____ Duration:_____

Activity Type (check as appropriate): ☐ Shore-based Activity (i.e. does not require boat/aircraft) ☐ Small Boat/Shore Activity (i.e. requires small boat transport to sampling location) ☐ Vessel-Based Activity	**Cell Phone Service Availability** (check as appropriate): ☐ Reliable cell phone service from ALL major providers, at all times. ☐ Reliable cell phone service from some providers at all times. ☐ Limited or no cell phone service at some times.
Access to Emergency Assistance (check as appropriate): ☐ Direct access to local EMS services within 15 minutes. ☐ Delayed access to local EMS services (15-45 minutes). ☐ EMS access requires vessel and/or air evacuation.	**Accountability System** ☐ NRDA ICP Houma Field Ops ☐ NRDA Offshore Cruises ☐ MC252 Air Ops ☐ Alternative System: Responsible Person: _____ 24hr Phone#:_____
Primary Form of Communication (check one or more): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System	**Secondary Form of Communication** (check as appropriate): ☐ Cell-Phone ☐ Satellite Phone ☐ Two-way Radio System ☐ Marine VHF ☐ EPRIB/PLB or SPOT Tracker
Additional Safety and Accountability Resources (check as appropriate): ☐ Directions to Medical Facilities / Staging Areas ☐ First Aid Kit ☐ Advanced First Aid Kit ☐ Medically Trained Personnel ☐ Handheld GPS	

TASK	**NRDA Shore Survey Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New **X** Revised	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Goggles *(tinted as necessary)* Tyvek Coveralls and Boot Covering Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Walking Shore	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Insect Bites / Stings	Use mosquito repellant; and maintain Sting Swabs in First Aid Kit.
	Eye strain (sun light)	Wear tinted eyewear.
	Animals (snakes, alligators, and other non-domestic types)	Careful placement of feet and hands; No open toed shoes.
	Fall Into Water	Wear Personal Flotation Device when 10-feet or closer to water.
	Loss of Communication	Establish and maintain communications with ICP Houma, other vessels, and never separate NRDA workers from vessel where communications cannot be maintained.
	Working alone	Maintain buddy system at all times, personnel should not work alone
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin as well as clothing	Wear Tyvek (or similar) boot covering and coveralls; Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.
Use of Tools	Cuts / Scrapes	Use tools as designed and refrain from over-exerting shovel tips where loss of control could happen.

TASK	**Small Boat / Air Boat Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	Personal Flotation Device (PFD) Safety Glasses or Sun Glasses Hearing Protection

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Vessel in Transit	Fall Overboard	Personal Flotation Device.
	No communication to/from vessel	All vessels must have a VHF Marine radio on board, permanently bolted to the structure
	Collision, Allision, or Grounding	Follow Navigational Rules of the Road; Maintain awareness; Know location; Maintain Communications.
	Overloading Vessel	Distribute weight evenly and do not exceed vessel capacity plate.
	Mechanical Issues	Keep spare parts, tools, etc. onboard and always know your fuel levels.
	Airborne Particulates and Insects	Wear safety glasses or safety goggles.
	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Pinch Points	Maintain control of doors/hatches; Keep fingers and feet clear of lines/ropes
	Noise	Double hearing protection must be worn onboard air boats.

TASK	**Air Operations**	**PERFORMED BY**	Caleb T. King (Coast Guard - Safety)
LOCATION	Heliports and along affected areas	**REVIEWED BY**	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New X Revised	**PPE REQUIREMENTS**	Hearing Protection Personal Flotation Device (PFD)

Issue of Concern / Activity	Potential Hazards	Control Measures
Boarding Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured
In Flight	Noise, Water Landing, Motion Sickness	Hearing Protection, PFD, Medication
Departing Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured

TASK	**Fencing/marking operations**	**PERFORMED BY**	Nir Barnea (Safety Officer)
LOCATION	Affected area	**REVIEWED BY**	
DATE PREPARED	11/22/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Work gloves • Goggles • Hearing Protection • Hard toe boots • Personal Flotation Device (PFD) if near water

Issue of Concern / Activity	Potential Hazards	Control Measures
Driving stakes in the ground	• Hand, finger and foot injury from hammer impact • Hand and finger injury from slivers and sharp stakes • Eye injury from flying particles • Hearing impact from excessive noise • Drowning if work is near water	**PPE:** Use gloves, goggles, hard toe boots, hearing protection, and PFD (when working near water) **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Pom-Pom Inspection**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Boat Launches/Marinas in Louisiana, Alabama, Mississippi and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	11/23/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Plate Glass in UV Box • Goggles (if plate glass is absent) • Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Pom-pom inspection under ultra violet light	• Skin irritation is possible if exposure occurs for long periods of time. • Eye inflammation and irritation is possible if looking directly at the source of radiation	**PPE:** Plate glass should be in place in the UV box. Goggles (or glasses) should be worn if plate glass is missing. Nitrile gloves should be worn when handling pom-poms. **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Chain drags**
LOCATION	Nearshore locations in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile Gloves • Safety Glasses • PFDs

Issue of Concern / Activity	Potential Hazards	Control Measures
Lifting and handling the chains	• Back strain from handling chain with improper form • Hand contamination • Potential hand or finger injury if catches in the chain.	**PPE:** Nitrile gloves should be worn if there is potential for contamination when handling sentinels, pom-poms, chains and seawater and other materials. PFDs should be worn on the water **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin	Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.

TASK	**Use of sharp objects (Scissors, wire cutters)**
LOCATION	Nearshore waters and shoreline from Louisiana to Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Stephanie Fardy
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Kevlar work gloves • PFD (if on the water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Use of sharp objects	• Cuts, scrape, etc.	**PPE:** Wear knit Kevlar work gloves when using sharp tools and a risk of cutting exists **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Oyster sample collection**
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Alāna Wilson
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile gloves • Knit Kevlar work gloves • PFD

Issue of Concern / Activity	Potential Hazards	Control Measures
Dredging	• Heavy lifting	**PPE:** • PFD (both on the water and when collecting samples from shore) **Administrative:** • Follow proper ergonomic behavior for heavy lifting • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available
Collection of oyster samples (via dredge, quadrat or by hand)	• Contact with sharp objects • Slippery footing in intertidal zones	**PPE:** • Wear disposable knit Kevlar work gloves OVER nitrile gloves anytime handling sharp objects (e.g. oysters) • PFD (both on the water and when collecting samples from shore) • Waders, with proper grip for walking during intertidal sampling

TASK	**Water quality testing**
LOCATION	Nearshore waters in Louisiana, Mississippi, Alabama and Florida
DATE PREPARED	11/23/2010 New [X] Revised [ ]

PERFORMED BY	Alāna Wilson
REVIEWED BY	Nir Barnea (Safety Officer)
PPE REQUIREMENTS	• Nitrile gloves • Goggles to prevent eye contact with the calibration solution if splash occurs

Issue of Concern / Activity	Potential Hazards	Control Measures
Calibration of water quality meter	• Contact with calibration solution	**PPE:** Wear nitrile gloves and goggles when calibrating the water quality meters **Administrative:** • Include MSDS in meter kit
Measurement of water quality parameters	• Contact with potentially contaminated seawater	**PPE:** Wear nitrile gloves when handling the meter probe and when lowering it into or pulling it out of the water

TASK	**Sampling in Phragmites**	**PERFORMED BY**	Allan Hooker
LOCATION	Phragmites stands	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/04/2003 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Kevlar gloves • Fully enclosed goggles • Full length, heavyweight shirt and pants • PFD (if on water)

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any work within Phragmites	• Eye injury • Skin punctures/abrasions • Drowning if work in near water	**PPE:** Kevlar gloves and full length shirt and pants should be worn to prevent skin punctures/abrasions. Fully enclosed goggles should be worn to protect the eyes. A PFD should be worn when working on or near the water. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

TASK	**Marine-based Operations in Cold Weather**	**PERFORMED BY**	Stephanie Fardy
LOCATION	Throughout Louisiana, Mississippi, Alabama and Florida	**REVIEWED BY**	Nir Barnea (Safety Officer)
DATE PREPARED	12/06/2010 New [X] Revised [ ]	**PPE REQUIREMENTS**	• Float Coats • Warm clothing

Issue of Concern / Activity	Potential Hazards	Control Measures
Performing any marine based operations when water temperatures are below 60 degrees Fahrenheit.	• Cold Stress (Hypothermia, Frostbite, Trench Foot, Chilblain-Red, Surface Transportation and Icing)	**PPE:** Multiple layers of clothing should be worn and clothing to protect the hands, feet and head should be worn to minimize effects of the cold. A float coat must be worn when water temperatures are below 60 degrees at any time during operations. **Administrative:** • Only perform work if PPE is worn • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available • Marine based operations must cease when air and water temperatures are both below 50 degrees Fahrenheit • No operations at night, in bad visibility, bad weather, when wind speed >25 knots, when small craft advisory issued • No operations on any vessel deemed unsafe for any reason or missing any necessary equipment such as VHF radio.

TASK	**Fill in general task**
LOCATION	Fill in location
DATE PREPARED	Xx/xx/xxxx New [X] Revised [ ]

PERFORMED BY	Fill in person performing hazard analysis
REVIEWED BY	Fill in person reviewing and approving
PPE REQUIREMENTS	• PPE 1 • PPE 2 • PPE 3

Issue of Concern / Activity	Potential Hazards	Control Measures
Fill in activity	• Hazard 1 • Hazard 2 • Hazard 3 • Etc.	**PPE:** Fill in specific PPE used **Administrative:** • Do not perform work requiring PPE until PPE is available and used. • Ensure buddy system • Ensure communication is working and nearest clinic/hospital location is available

MS CANYON 252 SAFETY CONFIRMATION

NAME: _____

CELL PHONE NUMBER: _____

EMAIL ADDRESS: _____

I HAVE READ AND UNDERSTAND THE MS CANYON 252 SITE SAFETY PLAN

_____SIGNATURE

_____DATE

I HAVE COMPLETED THE FOLLOWING LEVEL OF HAZWOPER TRAINING:

□ NONE □ 24 HOUR □ 40 HOUR

I HAVE COMPLETED THE FOLLOWING BP SAFETY TRAINING MODULE(S):

*NOTE: IF YOU HAVE COMPLETED THE ON-LINE TRAINING, YOU HAVE COMPLETED MODULE 3

□ MODULE 1 □ MODULE 2 □ MODULE 3

I HAVE COMPLETED FACE-TO-FACE TRAINING DURING THIS RESPONSE AT HOUMA

□ YES □ NO

EMERGENCY CONTACT INFORMATION

NAME: _____

PHONE NUMBER: _____

Please return this form, completed in its entirety, to either:
□ The drop box in Room G401 at the Houma Command Center, or
□ The following email address: dwhnrda@gmail.com

SUBJECT: Safety Plan

PREPARED FOR: NRDA (Natural Resources Damage Assessment),
Shore Survey Operations

1. INTENT

1.1. The intent of this Field Safety Plan is to establish a structured process and disciplined approach to the mitigation of health, safety and environmental risks associated with our operations and activities. This safety plan applies to the Natural Resources Damage Assessment (NRDA) Team.

2. COMMUNICATIONS

2.1. A daily pre-operations meeting will be conducted on-site with each team. Job Hazard Analysis' are located at the end of this document. Specific topics of discussion will include:

- Lessons learned from the prior day's mission.
- Current weather and short-term forecast.
- PPE requirements.
- Communications.
- Food and Water.
- Potential hazards to watch out for.

2.2. Each team is equipped with a cellular phone and/or a satellite phone. NRDA Field Teams will contact NRDA Operations (located at ICP Houma) as identified below to help ensure personnel accountability.

2.2.1. Departing for field sampling area.

2.2.2. Arriving field sampling area.

2.2.3. Four hour intervals during operations.

2.2.4. Departing field sampling area for day/shift.

2.2.5. Termination of operations (e.g. transition to over-the-road vehicle and/or arrival place of lodging).

2.2.6. As soon as practical to report any health, safety, security, or environmental incident.

2.2.7. Use one of the following NRDA Ops (ICP Houma) contact numbers:

2.2.7.1. PRIMARY - 985-746-4916

2.2.7.2. For non-routine issues and the above number can not be reached, CALL Nir Barnea (NOAA Safety) - 206-369-5015.

2.3. NRDA Team Members at ICP Houma will update the Shore Survey Teams Status Display upon notification from a NRDA Shore Survey Field Team.

2.4. Each NRDA Shore Survey Field Team will be provided with a copy of this safety plan.

3. VEHICLE SAFETY

3.1. Pre-Trip Plan (Maps, directions)

3.2. Seat Belt use is mandatory

3.3. Observe posted safety notifications and speed limits.

3.4. DRIVER - Cell phone use both hand-held and hands-free, texting, and e-mailing is prohibited while driving. If necessary, park in a safe location (off the road) and use while parked.

4. ACCIDENTS – INJURIES – SPILLS – NEAR MISSES

4.1. Accidents, injuries, spills or near misses must be reported to the NRDA Operations Supervisor as soon as practical. Required documentation will be managed by the NRDA Operations Supervisor with assistance by involved personnel. The NRDA Operations Supervisor will notify appropriate Incident Management Team personnel including the BP Safety Officer at the Incident Command Post in Houma.

5. TRAINING

5.1. Any member of a NRDA Field Team is required to have the following Safety Training.

- Required BP Safety Training
- HAZWOPER Certification
- PHI Helicopter Pre-Flight Safety Briefing

6. PERSONAL PROTECTIVE EQUIPMENT

6.1. Each NRDA Field Team Member is expected to utilize Personal Protective Equipment as appropriate for the activity being performed (refer to the Job Hazard Analysis incorporated within this document).

7. LEADERSHIP

7.1. While on an aircraft, boat or airboat, NRDA Team Members will follow pilot/co-pilot/captain/operators safety related instructions at all times. The NRDA Operations Supervisor is responsible for directing team activities and will help decide if safety issues preclude scheduled activities. All team members are responsible for individual and collective safety.

8. JOB HAZARD ANALYSIS (see following pages)

- Shore Operations
- Small Boat / Air Boat Operations
- Helicopter Operations

TASK	NRDA Shore Survey Operations
LOCATION	Various locations of affected areas
DATE PREPARED	5/8/2010 New X Revised

PERFORMED BY	Caleb T. King (Coast Guard - Safety)
REVIEWED BY	Lisa DiPinto (NOAA - NRDA Coordinator)
PPE REQUIREMENTS	Personal Flotation Device (PFD) Safety Glasses or Goggles *(tinted as necessary)* Tyvek Coveralls and Boot Covering Nitrile Gloves

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Walking Shore	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Insect Bites / Stings	Use mosquito repellant; and maintain Sting Swabs in First Aid Kit.
	Eye strain (sun light)	Wear tinted eyewear.
	Animals (snakes, alligators, and other non-domestic types)	Careful placement of feet and hands; No open toed shoes.
	Fall Into Water	Wear Personal Flotation Device when 10-feet or closer to water.
	Loss of Communication	Establish and maintain communications with ICP Houma, other vessels, and never separate NRDA workers from vessel where communications cannot be maintained.
	Working alone	Maintain buddy system at all times, personnel should not work alone
Activity where Personal Contamination is Anticipated	Hand contamination and/or other exposed skin as well as clothing	Wear Tyvek (or similar) boot covering and coveralls; Nitrile gloves; Safety Glasses or Goggles depending on liquid splash potential.
Use of Tools	Cuts / Scrapes	Use tools as designed and refrain from over-exerting shovel tips where loss of control could happen.

TASK	Small Boat / Air Boat Operations	PERFORMED BY	Caleb T. King (Coast Guard - Safety)
LOCATION	Various locations of affected areas	REVIEWED BY	Lisa DiPinto (NOAA - NRDA Coordinator)
DATE PREPARED	5/8/2010 New [X] Revised [ ]	PPE REQUIREMENTS	Personal Flotation Device (PFD) Safety Glasses or Sun Glasses Hearing Protection

Issue of Concern / Activity	Potential Hazards	Control Measures
Entering / Departing Boat	Wet surfaces, change in stability	Watch where you step; use available handrails; assistance by others.
Vessel in Transit	Fall Overboard	Personal Flotation Device.
	Collision, Allision, or Grounding	Follow Navigational Rules of the Road; Maintain awareness; Know location; Maintain Communications.
	Overloading Vessel	Distribute weight evenly and do not exceed vessel capacity plate.
	Mechanical Issues	Keep spare parts, tools, etc. onboard and always know your fuel levels.
	Airborne Particulates and Insects	Wear safety glasses, sun glasses, or prescription glasses.
	Heat Stress	Stay hydrated and take breaks. Monitor each other. Know symptom of heat stress and how do address them.
	Sun Burn	Apply sunscreen to exposed skin. Wear a hat with a brim to shade face.
	Pinch Points	Maintain control of doors/hatches; Keep fingers and feet clear of lines/ropes
	Noise	Double hearing protection must be worn onboard air boats.

TASK	Air Operations
LOCATION	Heliports and along affected areas
DATE PREPARED	5/8/2010 New X Revised

PERFORMED BY	Caleb T. King (Coast Guard - Safety)
REVIEWED BY	Lisa DiPinto (NOAA - NRDA Coordinator)
PPE REQUIREMENTS	Hearing Protection Personal Flotation Device (PFD)

Issue of Concern / Activity	Potential Hazards	Control Measures
Boarding Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter, keep all items secured
In Flight	Noise, Water Landing, Motion Sickness	Hearing Protection, PFD, Medication
Departing Helicopter	Noise, Tail Rotor, Rotor Wash	Hearing Protection, Never walk behind helicopter

NOAA	WATER COLUMN PROFILING SERVICES	CSA

Plan for Adaptive Water Column NOAA-NRDA Sampling (PAWNNS)
Cruise Plan – HOS Davis

GOM BLOCK

MISSISSIPPI CANYON 252

PROJECT HSE PLAN

NOAA

CSA International, Inc. (CSA)

REVISION STATUS			APPROVAL		
Rev	**Date**	**Reason for Issue**	**Originator**	**Reviewed**	**Approved**
A	4-May-2010	Issued for Comment	L. Powell		
B	7-May-2010	Changed vessel	F. Ayer		
C	7-May-2010	Changed HSE Manager	F. Ayer		
D	14-June-2010	Format revision/additions	L. Powell		

Dist:	**Subject**		**HSE Management**			
As per page 2	**Activity:**		**Project HSE Plan**			
	Location:		**GOM Block MC252**			
		Location	Disc	Document Type	Sequence No	Rev
	Doc. No.					**4**

PARTY APPROVAL FOR USE IN OPERATIONS

Bureau Veritas Stephen C. Donham, CIH HSE Manager	CSA Lynwood Powell HSE Manager

Record of Document Issue

Name	Company / Department	Copy No.	Date
Digital and Paper Copies			
NOAA			
Dr. Yong Kim	Chief Scientist, NOAA		
Bureau Veritas			
Stephen C. Donham, CIH	HSE Manager		
CSA			
Fred Ayer	VP/Project Manager-Stuart, FL		
Bruce Graham	Project Senior Scientist-Field		
Lynwood Powell	HSE Manager-Stuart, FL		
Tony Wadley	Site Safety Coordinator-Field		
Frank Johnson	Operations Director-Field		
Terry Stevens	Operations Manager-Field		
Gordon Stevens	Operations Manager-Stuart, FL		

TABLE OF CONTENTS

1.0 INTRODUCTION

NOAA will conduct a Water Column Profiling Survey (WCPS) to measure dissolved-phase aromatic hydrocarbons and free oil droplets as a function of depth and location relative to the subsurface oil release in Mississippi Canyon Block 252 (**Figure 1**). The objective of the project is to collect data to calibrate 3-dimensional modeling of subsurface oil plume structure, fate, and transport.

Several support vessels are chartered to conduct the survey operations for this project. The survey will consist of performing water column profiles using a General Oceanics model 1018 Rosette Water Sampling system and hydrographic profiles using a Seabird SBE-19 Profiling Conductivity-Temperature-Depth (CTD) and a variety of other water column sensors (Deep LISST, Aquatracka and Acoustic Back Scaterring devices). In addition a ROV system will be used to collect sediment and water samples and record video at the seabed. The survey vessels will deploy all sampling equipment at predetermined locations using a-frame/davit and winch systems. Within MC Block 252, water depths are expected to be approximately 5,000ft.

This document represents CSA International, Inc. (CSA) health, safety, and environment (HSE) policies and procedures for the NOAA WCPS. CSA is responsible for the overall safety management of the survey program.

Marine sampling can be inherently hazardous, and proper precautions need to be taken. Precautions for general vessel safety and chemical hazards to be observed on all CSA surveys are discussed in this document. The physical hazards unique to sampling equipment and operations and sampling precautions are discussed. The Project Scientist and the Site Safety Coordinator are responsible for ensuring that CSA HSE policies and procedures are consistently followed and enforced. Sampling activities will be suspended if the safety of the work crew cannot be ensured. Due to safety considerations all operations will be conducted during daylight hours only.

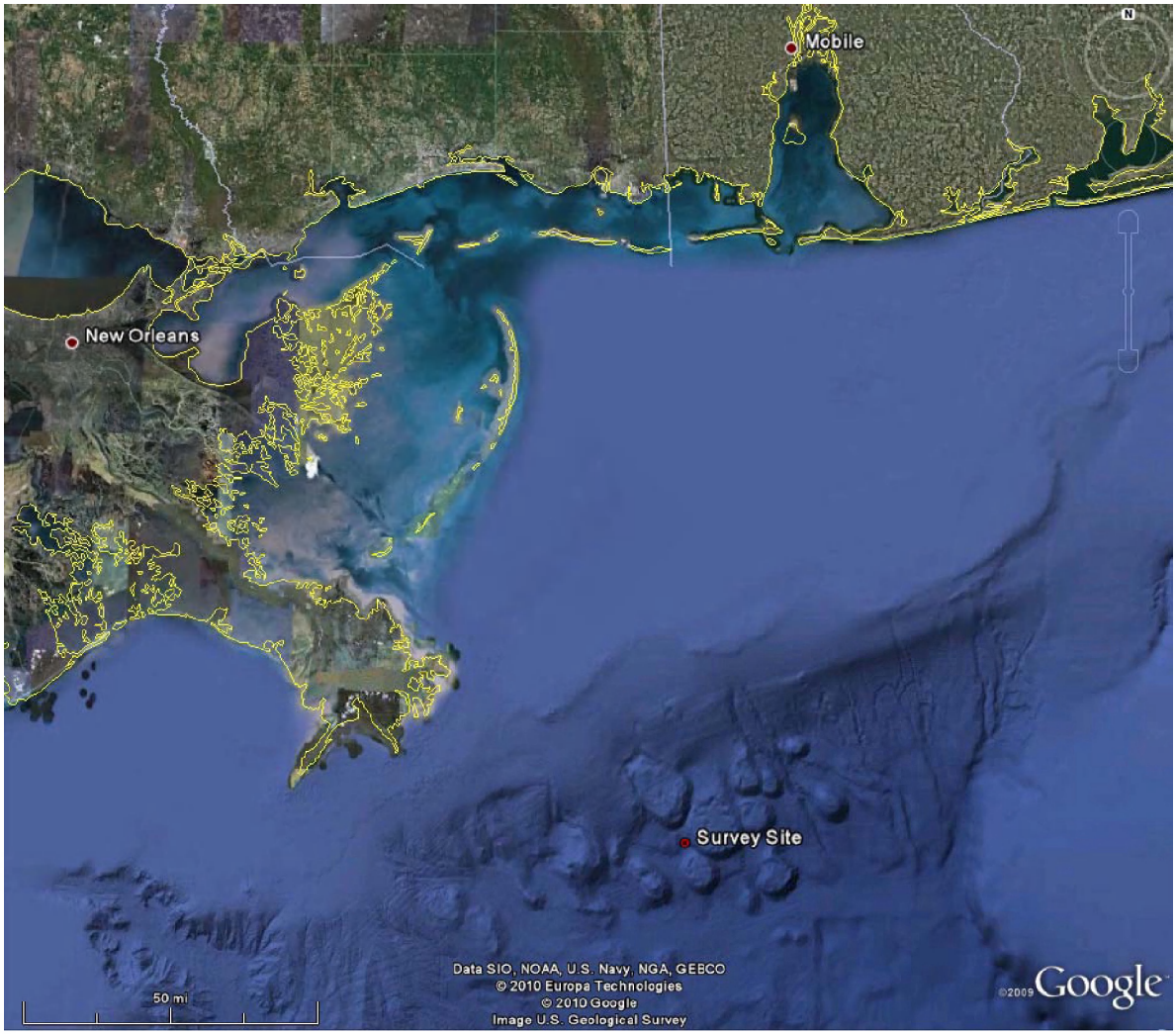


Figure 1. Location of Survey Site in Mississippi Canyon Block 252

1.1 General HSE Policy

This HSE Plan specifies the safety rules and standards for all CSA personnel and subcontractors during field onshore, shipboard, and laboratory activities. The HSE Plan is a tool to help implement and maintain the CSA safety policies and procedures.

1.1.1 CSA HSE Goals

The safety goal for CSA is to prevent all injuries, protect worker health, and cause no damage to the environment. CSA is vitally concerned for the health and safety of all its employees, subcontractors, facilities, and materials used during all phases of operations. We rely on each employee to actively support and implement the HSE policies and procedures. All CSA personnel are responsible for HSE compliance. The HSE policies are intended to create and maintain a safe working environment for all employees and protect the environment.

All employees and subcontractors are to be familiar with the client's HSE policies and work rules. In particular, all employees and subcontractors are to read from the client's corporate safety manuals all sections pertaining to:

- client sites that may be visited by CSA personnel during the conduct of CSA's work; and
- any activity which is procedurally similar to CSA's activities for the project.

PROJECT OPERATIONS WILL BE SHUT DOWN
IF SAFETY OF PERSONNEL CANNOT BE ASSURED

1.1.2 Site Safety Hazard Analysis and Risk Assessment

The Site Safety Coordinator will perform a site safety hazard/risk analysis as necessary for any special operations which might be required for this project. Safety procedures are routinely assessed for effectiveness specific to the project. The Site Safety Coordinator monitors safety procedures and evaluates them on a specific task by task basis. This information is relayed to the CSA Corporate Safety Supervisor and changes, if any, are made to further ensure personnel safety.

A project-specific Hazards Analysis/Risk Assessment is presented in **Appendix A**. **Table 1** provides the risk ranking descriptions. The HSE Risk Assessment was conducted for each potential hazard by ranking the consequence of the hazard and likelihood of the hazard occurring as summarized in **Table 2**.

Table 1. Risk ranking descriptions.

Risk Ranking	Description
A	Broadly acceptable
B	Tolerable
C	Subject to further study; identification of risk reduction measures and Cost Benefit Analysis
D	Subject to further study; identification of risk reduction measures and Cost Benefit Analysis
E	Unacceptable

Table 2. Risk matrix.

Likelihood of Occurrence		Consequence of Hazard				
		1	8	16	50	100
		Minor	Moderate	Major	Critical	Catastrophic
0.5	Insignificant	A (0.5)	A (4)	B (8)	B (25)	C (50)
1	Remote	A (1)	B (8)	B (16)	C (50)	D (100)
2	Infrequent	A (2)	B (16)	C (32)	D (100)	D (200)
5	Occasional	A (5)	C (40)	C (80)	D (250)	E (500)
10	Frequent	B (10)	C (80)	D (160)	E (500)	E (1,000)

1.1.3 Deviation from Safety Standards

Any deviation from the standard safety requirements as outlined in this HSE Plan and the client's particular Corporate Safety Manual shall be registered by the Site Safety Coordinator with the appropriate feedback from personnel. Follow-up by the Site Safety Coordinator requires reporting any deviations to the CSA Corporate Safety Supervisor.

1.1.4 Management of Change

If for any reason there is a request to make changes, the following will apply: The NOAA Representative will be notified of any changes to material, equipment, personnel, or procedures that could affect the safety of the operation or materially affect the scope or completion of the work.

Changes to any aspect of the work program will be subject to a risk assessment by CSA and NOAA to ensure any potential adverse effects of the change may be identified and either eliminated or controlled to minimize risk as much as reasonably practicable. Proposed changes will require the approval of the CSA Project Manager (or a designated representative) and the NOAA Technical Representative prior to implementation. Any such changes or additions to the operation and the subsequent risk assessment will be communicated prior to implementation to all relevant personnel likely to be affected by the change.

Any implemented change will be documented by completing a CSA Management of Change Order (See **Appendix C-Forms**).

2.0 LINE MANAGEMENT

Line management personnel outlined in each specific Survey Plan

2.1 Site Safety Coordinator

A Site Safety Coordinator will be designated for each survey. His/Her role in the project includes the following:

- HAZWOPER/CPR/First Aid trained;
- Ensures that first aid supplies are in good order and easily accessible;
- Conducts pre-mobilization safety briefing;
- Conducts daily safety/tool box meetings at the beginning of each day and notifies the client representative if any conditions or specific health and safety hazards will be encountered during the work to be done during the day;
- Responsible for ensuring all safety rules are followed and understood;
- Understands that if unsafe conditions exist, personnel are not required to work; and
- Will not rush to complete a job at the expense of safety.

2.2 Project Scientist/QA Coordinator

A Project Scientist/QA Coordinator will be designated for each survey. His/Her role in the project includes the following:

- Responsible for data collection and quality;
- First line of incident reporting;
- Coordinates daily survey progress assessment meetings;
- Responsible for reporting and recording all injuries, accidents, and near misses to the designated client representative on board and to the CSA home offices. The initial report will be oral, which will then be followed by a written record; and
- HAZWOPER/CPR/First Aid trained

2.3 Operations Manager

An Operations Manager will be designated for each survey. His/Her role in the project includes the following:

- Coordinates with Project Scientist on overall survey goals;
- Coordinates operations with ship's crew;
- Responsible for equipment installation and operation;
- Responsible for daily operations of sampling equipment; and
- HAZWOPER/CPR/First Aid trained.

2.4 Lead Technician

A Lead Technician will be designated for each survey. His/Her role in the project includes the following:

- Insure all sampling equipment is in proper working order;
- Inspects CSA equipment daily to ensure it is in proper working order;
- Assist in sample/data collection and processing;
- Responsible for implementing safety procedures; and
- HAZWOPER/CPR/First Aid trained.

**EACH EMPLOYEE IS RESPONSIBLE FOR HIS OWN AND OTHERS' SAFETY.
HE ALSO HAS AN OBLIGATION TO WORK SAFELY AND REPORT ANY UNSAFE CONDITIONS.**

3.0 HAZARD COMMUNICATION

3.1 General

All employees and contract personnel are informed of all potential health and safety hazards related to the project and are instructed on how to avoid the risk of an accident. When operating offshore CSA personnel will conduct daily meetings and communicate progress with onshore support. Personnel to relay program status and any logistical concerns and requirements via SAT Phone email.

3.2 Reporting

All survey personnel will be provided with sampling guides that summarize sample collection and processing activities and identify potential hazards.

In the event of an injury accident the Site Safety Coordinator initially will notify the Project Manager and/or Project Director and the client or its agent verbally. An Incident/Accident Notification form will be completed within 24 hours of an accident/injury/near miss and a copy will be sent to the CSA HSE Manager. "Incident/Accident Notification" forms (**Appendix C**) will be kept on site.

A daily progress report will be prepared for the HSE manager and will detail the technical aspects of the sampling acquisition as well as details and will include the following:

- Close calls/near misses;
- Any unsafe condition;
- Any CSA employee having a problem working safely;
- Any accident/incident;
- Any failure of safety equipment;
- Hazard reports & safety observations;
- Inspections & audits completed;
- Emergency drills completed;
- Personnel on Board;
- HSE issues or concerns; and
- Interaction with other vessels and fishermen

3.3 Project Site

Mobilization/Demobilization: Golden Meadow & Houma, Louisiana
Survey Site: GOM Block MC252
Schedule and Duration: Varies
Weather: Monitored and assessed daily

3.3.1 General Vessel Safety

To ensure adequate preparation for emergencies that may possibly arise, prior to selecting and/or chartering a vessel for survey operations, the Site Safety Coordinator will ensure that the proper safety equipment are or will be available when the vessel is mobilized for a survey. If any equipment are not available (e.g., in foreign countries where vessels of opportunity are used) arrangements should be made

to have the safety equipment made available either from in-country sources or by shipping them to the mobilization port.

3.3.2 Pre-Mobilization Safety Briefing (PMSB)

A Pre-mobilization Safety Briefing will be conducted by the CSA Site Safety Coordinator and the NOAA HSE Manager.

The following list is a summary of items to be discussed:
1. Description of project and goals
2. Communications – key to acquiring goals
3. Team members, assignments, and shifts
4. Coordination with ship's crew
5. Designation of person in charge on deck
6. Complexity of the operations – moving platform, machinery, openings
7. Pre-operation checks – vessel preparation
8. Safety equipment – vessel and sampling
9. Hazards - vessel and equipment – Hazid Actions/JSA/Toolbox
10. Limitations of personnel and equipment (Lifting, rigging, and safe working loads)
11. Environmental conditions (wind, weather, sea state, etc.)

An HSE induction for all personnel involved with the offshore field survey will be conducted by CSA prior to or during vessel mobilization.

All vessel crew members will be briefed on the operation of all primary sampling equipment, ROV systems, winches, blocks, cables, davits, a-frames, and other survey support equipment.

It is the responsibility of the Site Safety Coordinator and survey team members to ensure that proper rigging and lifting procedures are used.

The vessel's captain will be responsible for conducting the following drills: M.O.B., Fire, Abandon Ship, and Medical Emergency. These drills will be conducted once before the survey begins and weekly thereafter.

3.3.3 Chemical Hazards

Isopropyl Alcohol, Hexane, Acetone, and Liquinox are some of the chemicals which may be used during the field surveys. Additionally there may be personnel conducting surveys in areas where the oil spill dispersant COREXIT EC9500A has been used. Material Safety Data Sheets (MSDS) for each chemical product, including COREXIT EC9500A, will be aboard the vessel located near the chemicals and on the bridge. All personnel will be aware of the chemical products being used and safety considerations needed to prevent injuries.

The Site Safety Coordinator will ensure that field personnel review all relevant Material Safety Data Sheets (MSDS) before mobilizing for a field survey.

It is the responsibility of all personnel on board to take advantage of the information available, to wear the protective equipment provided, and to follow recommendations for handling any hazardous material.

Protective safety equipment will be worn when handling hazardous chemicals and include: chemical-resistant gloves, laboratory aprons, safety glasses or goggles, masks, and/or respirators.

In some areas, contact with marine sediment may present a potential health hazard from chemical and/or biological constituents of the sediment. Possible routes of exposure to chemical/biological hazards include inhalation, skin and/or mucous membrane absorption, ingestion, and injection. Potentially hazardous chemical/biological sediment constituents may include hydrogen sulfide, mercury and other heavy metals, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, solvents, and various types of bacteria and viruses. Other potentially hazardous substances may include chemicals used as sample preservative agents or sampler decontamination agents.

Crew members should exercise caution to avoid coming into contact with potentially contaminated sediment and water during sampling operations. Crew members should exercise good personal hygiene after sampling and prior to eating or drinking.

Exposure to airborne contaminants and the oil spill dispersant COREXIT EC9500A can be greatly reduced if the vessel steams to windward in a way that minimizes risk to the sampling crew from exposure to volatiles. Having respirators on hand will reduce exposure to volatile fumes that may be present when mixing large quantities of chemicals or using a solvent rinse during equipment decontamination.

During sampling caution, common sense, and good judgment should dictate appropriate safety gear to be worn in any given situation on deck. Hardhats, gloves, and steel-toed shoes must be worn in working conditions where there is a possibility of injury to the head, hands, or feet. Work vests must be worn at all times while working on the deck area. If in doubt, survey team members should ask the designated Site Safety Coordinator.

Collecting samples in extremely hot and humid weather carries the risk of dehydration and heat stroke. Survey team members should carry an adequate supply of potable water or other liquids for protection against dehydration in hot weather. The Site Safety Coordinator will ensure that survey team members continually drink to replace lost fluids in periods of work in hot weather. All survey vessels will provide adequate liquids for all survey team members.

3.4 Areas of Safety Concern

3.4.1 Mobilization

There is a large variety of marine sampling equipment in use today, and each has the potential for causing serious injury. Many types are heavy, ranging from under 50 lbs for a small sediment grab or plankton net to up to 2,000 lbs for a large Ewing piston corer. Unless the equipment is secure on deck or fully deployed and submerged, care must be taken to avoid crushing or other impact-related injuries from the handling of this gear.

This project will use a large ROV to collect all chemical and infaunal samples. The ROV is very heavy and all personnel must be aware of the corer weight and potential for uncontrolled motions during deployment and recovery. Proper tag line procedures will be stressed during the pre-mobilization briefing. Work gloves will be worn at all times when using tag lines.

Also, an appreciable amount of vertical clearance is usually required to clear the gunwale during sampling instrument deployment and retrieval, which in turn can increase the risk of uncontrolled lateral motion unless suitable tag lines are used.

A typical box corer is fairly heavy (from 200 to 900 lbs) and is also both tall and wide at the base. At least 100 square feet of deck area is required to safely manage this equipment. Good foot protection is mandatory when handling this equipment.

Essentially all types of sediment grabs utilize their own weight, some type of tensioning device, or other form of mechanical advantage to actuate the sampler upon contact with the bottom. Care must therefore be taken to minimize the risk of accidental or premature closure while handling. The box corer for this project has a release which triggers upon contact with the bottom. The sample is collected during retrieval.

In general, all sampling equipment uses the same type of marine hardware to attach to the appropriate lifting device. Periodically, all connections (e.g., cabling, shackles, pins, swivels, etc.) should be inspected to ensure the integrity of all points along the sampling assembly. The placement of the survey equipment on the deck will be discussed with the captain to assure safety and structural concerns are addressed. Welders attaching equipment to the vessel need to be certified in the operation of the welding and cutting equipment as well as using the appropriate materials to secure the equipment to the vessel. Tag lines will be attached to all equipment when it is being placed on or removed from the vessel.

Concern: Lifting equipment onto vessel.
Precaution(s): Lift with legs, back straight, good footing, and avoid twisting. Get help if load is too heavy. Avoid pushing, pulling, or prying while working aloft. Approved hard hats and safety boots/shoes with toe protection should be worn while working on the fantail.

Concern: Slippery deck.
Precaution(s): Guard rails; shoes, boots with sufficient anti-skid soles to minimize potential for slippage; employees to wear personal floatation device (PFD) while on the work deck at sea and if transfers are required.

Concern: Installation of equipment.
Precaution(s): Secure all equipment in case of rough seas. In the case of installation of navigational antenna and cables, two people will be on hand at all times for this part of the mobilization and will inform vessel captain of antenna installation and positioning and have the radar unit switched off (antennae should not be moving).

Concern: Loose containers.
Precaution(s): Secure all shipping containers to ensure they cannot break loose and cause physical harm during rough sea condition.

Concern: Confined space.
Precaution(s): Keep clean and ventilated. Check for proper lighting. Conform to vessel permit to work and confined space entry requirements

Concern: Lock out/tag out procedures (faulty equipment).
Precaution(s): Unplug equipment before doing repair and tag it as such. Reactivate the system only through an established and published procedure that ensures each person has removed his own lock and tag first.

Concern: Installation of first aid kit.
Precaution(s): Ensure all personnel are aware of the location of the first aid kit on the vessel.

Concern: Location of fire extinguishers.
Precaution(s): Ensure all personnel are aware of the location of the fire extinguishers on the vessel.

3.4.2 Offshore

A sampling device is least secure while suspended in the air during the transitional period between the deck of a vessel and the surface of the water; a pitching and/or rolling deck during rough weather will

aggravate this situation. Care must be taken to ensure that sufficient restraining, or tag lines or other devices are in place to meet these conditions. Because of the increased potential for damage or injury, all personnel on deck and in the wheelhouse must be notified before a sampling device leaves the deck during deployment or breaks the surface upon retrieval. If the winch operator is remotely located from the scene of operations, a clear system of signals must be established between the lead deck person and the winch operator, usually via hand signals or electronic communication.

OSHA requires that hard hats be worn when working beneath suspended equipment, or when the potential of injury to the head exists due to lateral impact. All crew members should have a suitable level of seamanship skills, based upon their level of responsibility. Listed below are some of the items related to seamanship and gear-handling that, when overlooked, have been known to cause serious accidents on board ship.

- A capstan is potentially more dangerous than a winch drum, as the wraps are not enclosed and could instantly slip off the end if not handled properly.
- If a hydraulic hose fails, winches can free-wheel, and load-bearing rams can collapse under a load unless backed up with balance-check valves.
- Different kinds of line and wire rope have different characteristics, which may not be suitable for all applications (e.g., nylon is 25 percent stronger than polypropylene, but it is much more elastic and can be lethal if parted under a strain; polypropylene will float, making it less susceptible to propeller entanglement).
- An eye splice over a thimble will only cause a 5 percent reduction in line strength, but a knot (depending on type) can reduce the strength in a line by as much as 55 percent due to unequal strain on the fibers (a line will usually break under a strain at that point where it is forced to bend).
- Theoretically, the longer a line under a strain, the weaker it is when compared against its rated breaking strength (the chances are statistically greater of encountering a section weaker than the last as line length increases).
- The recommended working load-to-breaking strain for wire rope and line is typically 1 to 5. If the load ever exceeds 75 percent of the breaking strength, permanent damage could result, which can lead to unexpected breakage.
- Topside operations may be more dangerous on larger ships than smaller vessels because it is harder to keep track of safety concerns when activities are spread over a larger area of deck.
- Crew members should always stand clear of slack or looped line lying on deck to avoid entanglement. A sudden strain on slack line can entrap arms and legs; personnel may be severely injured or carried overboard.

In the event the sediment grab or winch wire becomes entangled in an object on the bottom, in the ship's propellers, or as a result of a malfunction in the winch or a-frame, the personnel on the bridge will be notified immediately.

The Operations Manager conducting sampling operations will confer with the ship's master and will direct the survey team members and vessel personnel in order that the situation is safely resolved.

Inclement weather may introduce additional hazards. Heavy equipment can be much more difficult to manage, and footing may become unsure due to slippery decks and/or increased vessel motion, and the risk of falling overboard may increase. Some state agencies requires that all railings be a minimum of 36 inches in height, and OSHA requires that an approved life vest be donned when working over the water or if there is an increased risk of falling overboard. A safety line will be secured across the opening from which the survey equipment will be deployed and retrieved. Vessel accommodations should be able to provide relief to crew members in case of cold or heat stress.

The vessel's Captain is responsible for determining the relative safety due to inclement weather on all operations. If necessary, survey operations will be suspended. The Captain will decide whether to stay on station or transit to port until weather conditions improve. If operations are suspended the Operations Manager will direct the movement and securing of equipment and materials until sampling resumes.

Concern: Chemicals.
Precaution(s): Familiarization with use and handling of chemicals to be used on project. Splash-proof goggles, organic vapor masks, and protective gloves will be used when handling chemicals. Chemicals will only be used in well-ventilated areas.

Concern: Acids, bases, and other hazardous chemicals.
Precaution(s): Briefing and MSDS sheets regarding all hazardous chemicals. Use of rubber gloves when handling dangerous chemicals such as water quality fixatives. Availability of first aid kits, eye wash kits, and spill kits. Prior to applicable activities, the Site Safety Coordinator will remind survey team members of the location of first aid kits, eye wash kits, and spill kits.

Precautions should be taken when handling hazardous materials during sampling and sample processing. Gloves and safety glasses should be worn as needed.

Concern: Man overboard.
Precaution(s): Single (one) employee is not allowed on rear deck of the vessel alone – two men or more are required on deck during at-sea operations. All employees are to wear PFDs while on deck of the vessel.

3.4.3 Winch and Davit Operations and Safety Procedures

CSA will be utilizing the services of subcontracted vessel operators who will provide suitable vessels to facilitate the sampling effort. An a-frame/davit will serve as the deployment/retrieval system for the rosette water sampler. The a-frame/davit is welded to the gunwale and deck and is constructed to safely handle any loads anticipated for the field survey tasks. The winch will be the CSA deepwater electro-hydraulic unit manufactured by Sea-Mac.

CSA is responsible for training field personnel in the safe working procedures of the equipment being utilized for this project. Under the terms of the contract, CSA and subcontracted vessel operators will provide competent personnel to carry out the work. As such CSA and subcontracted vessel operators will address the a-frame/davit, and winch systems which include electro-hydraulic winches and hydraulic power units (HPU). The purpose of this document is to outline a systematic approach to mobilization, training, and standards which will optimize safety and program efficiency.

Systems safety and operational planning and implementation are a two-tier function:

1. Pre-cruise planning will address the specific operational requirements associated with the equipment. It is the responsibility of the Operations Manager to ensure that all requirements relative to mobilization, operation, and maintenance are implemented through in-house planning and discussion.

2. On-board, prior to the actual operation, it is the Operations Managers responsibility to coordinate mobilization, training, and operational procedures with the vessel's Captain and crew, CSA Technicians, Project Scientists, and Operations group. This is to ensure that all individuals involved clearly understand what is required of them and that all equipment is appropriate and have been inspected.

The following points will be addressed during the Pre-mobilization Safety Briefing and Operations Training:

- Read all warning tag information and become familiar with all controls before operating winch.
- Never attempt to clean, oil, or perform any maintenance on a machine with the engine or prime mover running, unless instructed to do so.
- Never operate winch controls unless you are properly positioned at the operator's station and you are sure personnel are clear of the work area.
- Assure that personnel who are responsible for hand signals are clearly visible and that the signals to be used are thoroughly understood by everyone.
- Ground personnel should stay in view of the operator and clear of winch drum. Do not allow ground personnel near winch line under tension. A safe distance of at least 1-1/2 times the length of the unspooled cable should be maintained.
- Inspect rigging and winch at the beginning of each work shift. Defects should be corrected immediately.
- Keep equipment in good operating condition.
- Do not exceed the maximum pressure, PSI (kPa), or flow, GPM (LPM), stated in the winch specifications for hydraulically driven winches.
- Match winch line speeds to job conditions.
- Leather gloves should be used when handling winch cable.
- Never attempt to handle winch cable when the hook end is not free. Keep all parts of body and clothing clear of cable rollers, cable entry area of fairleads and the winch drum.
- When winding winch cable on the winch drum, never attempt to maintain tension by allowing winch cable to slip through hands. Always use "hand-over-hand" techniques, being careful to keep hands and clothing away from winch drum and fairlead rollers.
- Never use winch cable with broken strands. Replace winch cable.
- Do not weld on any part of the winch.
- Use recommended hydraulic oil and gear lubricant.
- Install guarding to prevent personnel from getting any part of body or clothing caught at a point where the cable is wrapped onto the drum or drawn through guide rollers.
- Install switches or valves which will shut off power to the winch in locations where they can be reached by anyone entangled in the cable before being drawn into the winch or any "pinch-point."
- "Deadman" controls, which automatically shut off power to the winch whenever the operator leaves his station, should be installed whenever practical.
- Never allow anyone to stand under a suspended load.
- Avoid sudden "shock" loads or attempting to "jerk" load free. This type of operation may cause heavy loads in excess of rated capacity, which may result in failure of cable and winch.
- It is imperative that the person operating the unit follow directions while maintaining situational awareness for the task at hand.

Never put your hands into, around, or near the spool or rollers when operating.
Serious injury can occur!

3.4.4 Demobilization

At the completion of all planned survey tasks there can exist the opportunity for injury due to survey team members and ships crew rushing demobilization efforts. When these demobilization procedures are performed too quickly the risk of an accident is increased.

3.4.4.1 Offshore

Concern: Personnel anxious to disembark vessel.
Precaution(s): Must use cautious, methodical procedures.

Concern: Loose trash/debris.
Precaution(s): All trash/debris will be stored and removed.

Concern: Transferring equipment/personnel from vessel to dock. Dropped objects
Precaution(s): PFDs required (see also slippery deck hazard).

3.4.4.2 Onshore

Concern: Personnel anxious to disembark.
Precaution(s): Must use cautious, methodical procedures.

Concern: Loose trash/debris.
Precaution(s): All trash/debris will be stored and removed.

Concern: Safe disposal of trash, hazardous chemicals, fixatives, etc.
Precaution(s): Careful identification, marking, disposal, packing, and transport (if required) of hazardous materials. Proper neutralization of chemicals will be completed if required.

Concern: Leakage of sample preservatives (i.e. formaldehyde).
Precautions: Briefing on safe handling of formaldehyde and other possible fixatives. Double bagging of fixed samples, eyewash capabilities, flushing of neutralization of skin contact.

3.5 Emergency Program

The vessel master has a direct responsibility for the health, safety and welfare of all persons on board and for dealing with the immediate response to emergencies. In the event of an emergency CSA will provide emergency response management in cooperation with the vessel's captain to insure the health, safety, and welfare of all persons on board. The Site Safety Coordinator will work along side the captain in the event of a medical emergency.

In the event of injury or illness to personnel, CSA have responsibility for the evacuation of any person on board from the vessel to the nearest port or heliport, depending upon the nature and severity of injuries. From there CSA have responsibility to transfer their own and subcontractor personnel to hospital for treatment. NOAA has responsibility for the transfer, hospitalization and ongoing welfare of their own personnel. CSA and their subcontractors have full responsibility for the response to and management of all emergencies arising onboard or involving the vessel.

CSA will mobilize a First Aid Kit for each survey. All CSA personnel are trained in First Aid administration.

3.5.1 Personnel on Board (POB)/Next of Kin (NOK)

A POB/NOK list for the vessel shall be issued prior to departure from the harbor and will be updated should personnel change out, which is not currently planned. Copies of the vessel POB/NOK lists will be transmitted to CSA and NOAA offices. All parties will undertake to keep the NOK information confidential.

In the event of an emergency, CSA where necessary shall liaise with the relevant authorities and provide a verified POB list. The onshore response personnel of CSA (and 3rd party contractors if necessary), will

be responsible for providing support to relatives of CSA personnel and subcontractors on board during an emergency. The NOAA response team would take this responsibility for NOAA vessel personnel.

Prior to vessel mobilization medical evacuation support services were researched in south Louisiana. A hospital and helicopter service, identified prior to mobilization, will be contacted in the event of an emergency.

3.5.2 Overall Strategy

An emergency is defined as an unplanned event, or situation, which poses an actual or potential threat to the safety or integrity of:

- Life and limb or health of personnel on board the vessel
- The environment or,
- The reputation of CSA or NOAA

An emergency can be further defined as any event, incident or situation, which poses a continuing threat and requires the mobilization of assistance or support from sources external to the affected party.

Both offshore and onshore emergency response actions will be clear, co-coordinated and will be based on the agreed arrangements listed in this document.

CSA emergency response team will take the lead role in responding to all emergencies.

Local services will respond in an emergency to provide support to CSA. Depending upon the nature and scale of the emergency, the CSA shore support may also respond.

In event of an emergency, a number of CSA personnel will remain on call for the duration of the NOAA contract. CSA will have a team on standby in Florida to provide support, consisting of the CSA HSE Manager, an Operations Manager, and other support personnel as required.

Vessel

The vessel captain and the CSA Site Safety Coordinator in cooperation with the NOAA HSE field representative will insure Muster, Fire, MOB, loss of power, and Communication drills will be run before beginning field tasks. The Fire drill will include pressure to and discharge of the fire hoses.

3.5.3 Post Event Incident Reporting

Formal written reports will be prepared by CSA after an emergency has been resolved. A report need not be final, but may be an interim or preliminary document. A report should not only identify the sequence of events and causes of the incident, but also the adequacy of the response and corrective actions.

3.5.4 Emergency Response

Responsibilities during an emergency include the following:

Offshore Response

Vessel Master	
Responsibility:	Safety of all persons on board the vessel Overall control of the vessel Emergency Response Team On-scene commander Liaison with other vessels if in the survey area Obtaining medical advice as required
Actions:	Controlling emergency and safeguarding personnel Notify the relevant authorities, if necessary Notify CSA On-Duty Operations Notify the NOAA representative on the vessel Calling onshore medical authorities
NOAA HSE Representative	
Responsibility:	Providing assistance to the Vessel Master as requested Initial notification of NOAA HSE Manager
Actions:	Call duty person as above and inform them of nature of emergency and onshore assistance if required.

Local Onshore Response

CSA Project Manager	
Responsibility:	Primacy for supporting the vessel and coordinating the onshore emergency response in accordance with CSA Emergency Response procedures.
Actions:	Coordination of emergency response via the existing CSA emergency response organization and arrangements, including provision of logistical support Notification of and Liaison with external agencies including Medical Support Notification and regular updating of NOAA representative. Informing CSA personnel and subcontractor NOK of injuries etc. Arranging medivacs to shore in response to injuries, illness or other incidents on board for all POB. Arranging reception and transfer to hospital for any injured CSA or subcontractor personnel
NOAA HSE Manager	
Responsibility:	The health, safety and welfare of NOAA personnel involved in any emergency, once they have returned to shore. The reputation and standing of NOAA
Actions:	Mobilize to NOAA offices in response to call out from NOAA Survey Rep. Keep updated of events via CSA emergency personnel Make arrangements to meet and greet any injured or affected NOAA personnel in port or heliport as required Arrange transfer and hospitalization of injured NOAA personnel as required Arrange for medivacs as required for NOAA personnel Ensure notification of NOK for any affected NOAA personnel. Seek support on preparation and issue of media statements as required, in conjunction with CSA.

3.5.5 Emergency Response Organization

The response organization for the baseline environmental survey is shown in **Figure 2** below. Call out and communication routes are also shown in this figure.

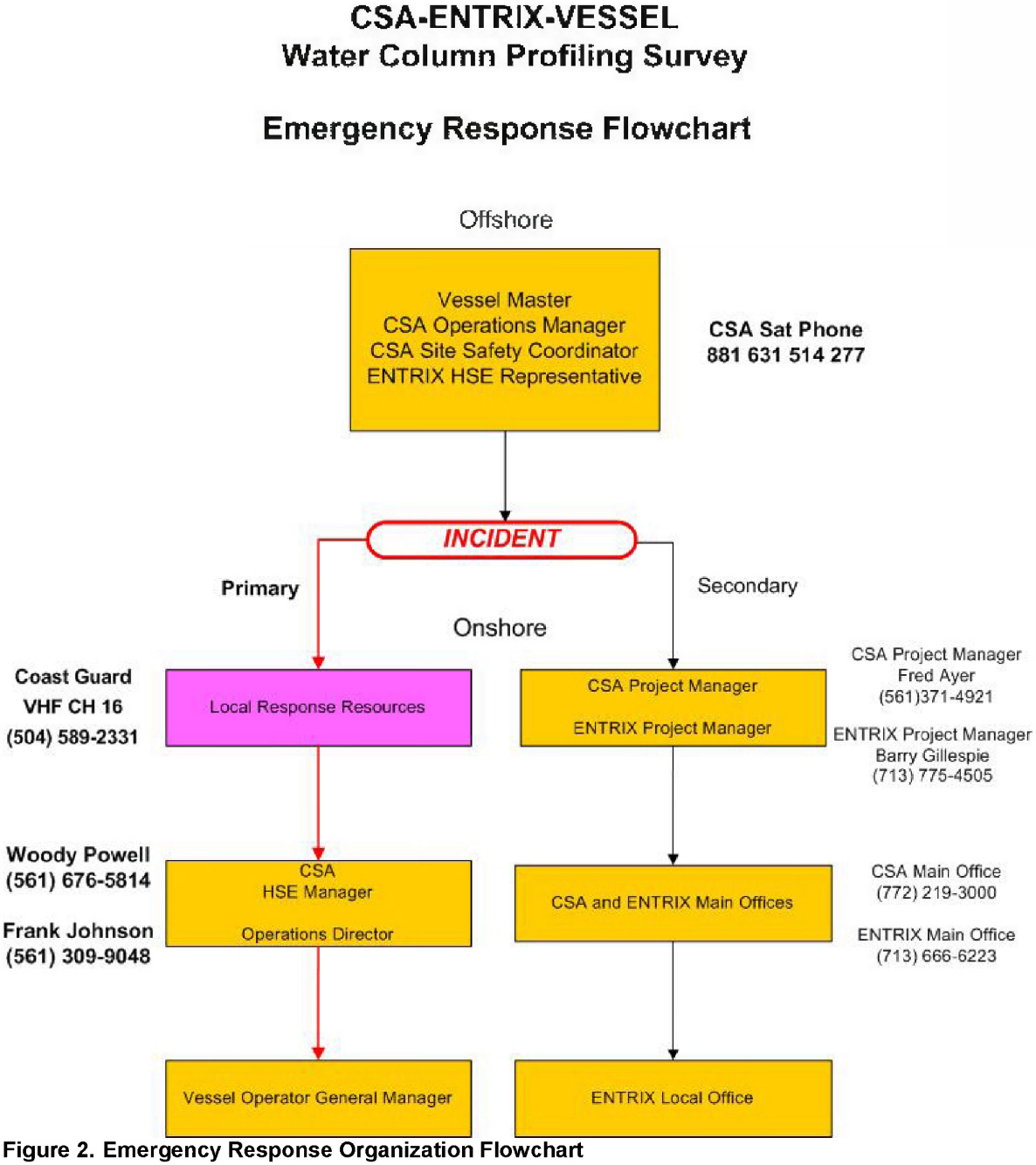


Figure 2. Emergency Response Organization Flowchart

3.5.6 Medivac Plan

Should a medical emergency require the immediate evacuation of a person or persons from the survey vessel, the vessel should immediately head toward the nearest shore facility. The Coast Guard should be contacted immediately on VHF channel 16. The Coast Guard air station is located approximately 13 miles south of New Orleans in Belle Chasse, La

Any applicable client transport coordinators or helicopter dispatchers should be contacted by either satellite phone or cellular telephone for assistance with the emergency. They will arrange helicopter evacuation of the injured person(s) from the platform or shore facility to the nearest emergency medical facility. If medical treatment is needed for a non-life threatening situation, the vessel should head to the nearest shore facility from which the injured person(s) can then travel to the nearest medical facility to obtain necessary medical treatment.

The arrangements listed in this document shall apply to the Emergency Response Procedures for the period that the vessel is contracted for the purpose of completing the survey.

Emergency contact numbers for communications during emergency situations are provided below.

Vessel Emergency Contact Numbers

Vessel	
Master	Will be provided for each vessel
Satellite Phone	985 520-4376
Vessel Call Sign	Will be provided for each vessel
Vessel Manager	Will be provided for each vessel

CSA Emergency Contact Numbers

CSA	
Satellite Phone-OnBoard Vessel	**985 520-4376**
Fred Ayer, CSA Project Manager	+1 772-219-3039 (Office) +1 561-371-4921 (Mobile)
Gordon Stevens, CSA Operations	+1 772-219-3076 (Office) +1 407-310-3053 (Mobile)
Lynwood Powell, HSE Manager	+1 772-219-3040 (Office) +1 561-676-5814 (Mobile)

NOAA Emergency Contact Numbers

NOAA
Jenna Cragan 401 316-5600

4.0 MEDICAL/FIRST AID PROGRAM

CSA personnel are all properly trained in cardio-pulmonary resuscitation (CPR) and first aid. Training allows CSA personnel to give immediate and temporary care to a victim of an accident or sudden illness until a physician can be obtained. This effective first aid consists of common sense, training, and knowledge of the following:

- Procedures for treating bleeding;
- Procedures for heart attack victims;
- Procedures for choking victims;
- Procedures for treating victims of burns;
- Procedures for treating electric shock victims;
- Procedures for treating victims of exposure to chemicals;
- Procedures for treating victims of inhalation of toxic gas or smoke;
- Procedures for treating shock victims;
- Procedures for treating victims of heat exhaustion;
- Procedures for treating victims of heat stroke;
- Procedures for treating victims of frostbite;
- Procedures for treating victims of hyperthermia; and
- Procedures for treating victims of skin poisoning or swallowed poisons.

5.0 SUBSTANCE ABUSE PROGRAM

CSA is committed to maintaining a drug-free workplace. In recognition of the dangers to our employees and the company of drug abuse in the workplace, and pursuant to the provisions of the U.S. Drug-Free Workplace Act of 1988 and Federal Acquisition Regulation 23.504, all employees are subject to the following:

- Unlawfully manufacturing, distributing, dispensing, possessing, or using a controlled substance is prohibited in the workplace.
- Any employee who unlawfully manufactures, distributes, dispenses, possesses or uses a controlled substance in the workplace will be subject to discipline up to and including dismissal.
- All employees, as a condition of continued employment, must abide by the statement and are required to notify the company of any criminal drug statute conviction for a violation occurring in the workplace no later than five days after such conviction.
- This Drug-Free Workplace Statement does not amend, limit, restrict, modify or otherwise alter any other company rules, regulations, procedures or policies.

CSA employees tested for substance abuse must meet the U.S. Department of Transportation (DOT) standards for drug and alcohol testing to be able to work as CSA's representatives on designated projects. The medical forms may be made available for the client's inspection with prior approval from the employee.

DOT regulations require screening for the following drugs (known as the NIDA 5 Panel):

- Marijuana;
- Barbiturates;
- Opiates;
- Amphetamines;
- PCP; and
- Cocaine.

6.0 PERSONAL PROTECTIVE EQUIPMENT SAFETY PROGRAM

The following outlines CSA policy pertaining to the issuance and use of certain personal protective equipment (PPE) that will be issued by CSA. Each employee will be responsible for ensuring his PPE is kept clean and in good working condition.

Protective gear for sampling personnel should include the following:

- a hard hat;
- steel-toe shoe/boots;
- work vest;
- equipment handling and chemical-resistant gloves (e.g., leather or Nitrile);
- safety glasses/goggles;
- respiratory protection;
- rain gear (if necessary);
- coldwater survival gear (if necessary); and
- hearing protection (if safe noise levels are exceeded).

In addition to the above PPE personnel deploying and retrieving equipment over the side of the vessel will be required to wear a safety harness and utilize a retractable lifeline securely connected to a point on the vessel.

It is important to note that the ship's captain has the ultimate responsibility and authority to immediately override the authority of all other on board personnel, especially where the general welfare of crew and vessel are concerned.

During the dockside mobilization, the Site Safety Coordinator will conduct an inventory of the safety-related equipment and materials and provide a report to the Project Scientist and Operation Manager of their status, location, and availability.

Hard Hats. Each employee will be expected to wear a hard hat at all times when working out on deck. These safety hats will meet the specifications contained in American National Standards Institute, Z89.1-1969, Safety Requirements for Industrial Head Protection.

Steel-toed Shoes/Boots. Steel-toed shoes or boots will be required while outside of office area or on any work site, e.g., work deck.

Gloves – Work and Chemical. Work gloves will be provided for handling of equipment and supplies to reduce the potential of hand injuries. Nitrile, rubber, gloves will be provided for the handling of all chemicals and solvents.

Safety Glasses/Goggles. All employees will be issued and must wear approved safety glasses with side shields at all times while in the work area. Those employees who wear prescription glasses will wear safety glasses over their glasses. This also applies to those employees who wear contact lenses.

All employees will be issued and expected to wear 1) approved impact-type goggles with side shields when engaging in any activity that involves hazards to the unprotected eye from chipped or flying particles; and 2) approved splash proof goggles when they are handling hazardous chemical liquids, powders, or vapors as well as when they are in the vicinity of these chemicals.

Employees who wear prescription glasses will wear goggles over their glasses. This also applies to employees who wear contact lenses; these employees must make it apparent that they do wear contact lenses.

Respiratory masks
Protective respiratory mask will be provided to all employees. Any employee handling chemicals or solvents is required to wear a respiratory mask in addition to gloves and goggles.

Protective Outerwear
An outerwear capable of protecting the employee from oily products will be worn during all sampling operations. A Tyvek or suitable alternative is required.

Rain gear
Rain gear is not provided for most offshore surveys. It is the responsibility of the employee to provide adequate protection when working outside of the confines of the vessel.

Cold water survival gear
Cold water survival gear will not be necessary for this survey due to the time of year and the location of the survey area.

Hearing protection
Hearing protection is mandatory in all designated high noise areas. Ear plugs and ear muffs will be provided.

During operations which require special equipment and outerwear, the previously mentioned mandatory equipment and requirements pertaining to the equipment may be voided or amended.

7.0 HEARING CONSERVATION PROGRAM

All employees will wear the appropriate hearing protection provided by CSA while in a high noise area (85 decibels [dBA] or above for an 8-hour time period). A sign will be posted in high noise areas.

The Site Safety Coordinator will ensure any employees working in a high noise area are wearing hearing protection.

CSA also urges its employees to use common sense in a "noisy environment." If it is necessary to shout to communicate, an area is considered a high noise area whether or not signs are posted.

8.0 LIFE SAVING EQUIPMENT

All personnel working or riding on the deck of a boat or barge, or when transferring between vessels or onto a platform, must wear a U.S. Coast Guard (USCG)-approved PFD with reflector tape strips. There will be one PFD for each employee. On-board personnel should familiarize themselves with the ship's man overboard procedures and the vessel's life saving equipment location.

9.0 MOB AND FIRE EMERGENCY PROCEDURES

9.1 MAN OVERBOARD

- Throw a ring buoy overboard as close to the person as possible.
- Notify the personnel on the bridge immediately; bridge records vessel position.
- Post a lookout to keep the person overboard in sight.
- Maneuver the vessel to pick up the person in the water.
- Crew member wearing a PFD attaches a safety line and stands by to jump into the water to assist the person overboard if necessary.
- If person is not immediately located, notify Coast Guard and other vessels in the area by radio telephone.
- Continue search until released by the Coast Guard.

9.2 RULES FOR ABANDONMENT

- Review rules posted on vessel prior to vessel leaving dock.
- Take instructions from vessel's captain and proceed to pre-assigned station on the vessel.

9.3 FIRE ON BOARD

- Review rules posted on vessel prior to vessel leaving dock.
- When alarm sounds proceed to pre-assigned station on the vessel.
- Vessel's captain will instruct survey team members.

10.0 WATER SURVIVAL PLAN

All employees must become familiar with the use and operation of survival gear and emergency instructions posted on the vessel.

In case of vessel evacuation:

1. Put on a PFD and remove your safety hat.
2. Do not dive into the water but jump in feet first.
3. If swimming in rough water, turn your back to the wind or waves. Keep your head out of water and use a breast stroke.
4. If there is an oil or fuel fire on the water, swim UNDER the water. Before surfacing, use your hands to splash a breathing hole above your head. Close your eyes before surfacing, take a breath, and then resubmerge (feet first).
5. If there is oil and/or debris on the water surface, keep your head up and out of the water. Push the oil/debris away from you as you swim. Protect eyes, nose, and mouth.
6. If swimming in cold water, conserve body heat, and help to prevent hypothermia by minimizing movement.
7. Do not swim to rescuers – let them come to you.

CONSERVE YOUR ENERGY! YOUR SURVIVAL MAY DEPEND ON IT!

11.0 EQUIPMENT INSPECTION PROGRAM

CSA will insure the following equipment is aboard the vessel:

- Fire extinguishers;
- PFDs;
- Safety Harnesses;
- Retractable lifelines;
- Ear protectors;
- Hard hats;
- Safety glasses;
- Safety shoes;
- Organic vapor masks; and
- Protective gloves.

The above equipment shall be inspected daily prior to use for wear and tear and so noted by the designated CSA safety person in his Project Log. During daily inspections, emphasis will be put on equipment security (i.e., safely secured for rough seas), and equipment maintenance.

The safety person will be knowledgeable with U.S. 29 CFR 1926 (Subparts E, F, I, J, K, L, N, and O): Personal Protective and Life Saving Equipment; Fire Protection and Prevention; Tools (Hand/Power); Welding and Cutting; Electrical; Ladders and Scaffolding; Cranes, Derricks, Hoists, Elevators, and Conveyors; Motor Vehicles, Mechanized Equipment, and Marine Operations.

12.0 ELECTRICAL SAFETY PROGRAM

12.1 INSTALLATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT

All installation and maintenance of electrical equipment must comply with the pertinent provisions of the national electrical code. All electrical work will be performed by competent personnel who are familiar with code requirements and qualified for the class of work to be performed. All applicable electrical wire, apparatus, and equipment will be of a type approved by Underwriters Laboratories, Inc., Factory Mutual Engineering Corp., or any other nationally recognized testing laboratory.

12.2 ELECTRICAL ACCIDENT PREVENTION PROCEDURES

The best qualified available employee will be appointed to be the electrical job supervisor. That person will have total responsibility for the electrical work.

Each job should be thoroughly planned, making sure that adequate and proper equipment and sufficient personnel are available to perform the job safely. No job is to be rushed to completion at the expense of safety.

A special safety meeting will be conducted before starting a job to brief all workers involved to make sure all questions are answered and that no confusion exists among the workers.

All possible circuits in the vicinity of the work area should be de-energized and secured in this condition by grounding, locking, and tagging. If it is not possible to de-energize all circuits, use barriers, rubber goods, or any other protective equipment necessary to make the work area safe. Danger signs will be displayed in appropriate locations and on associated equipment as required to afford maximum personnel protection.

Complete attention should be devoted to the job at hand. Preoccupation or day-dreaming cannot be tolerated while working with electrical equipment.

Even low voltage (e.g., 32 volts AC) as well as many battery-powered systems are hazardous and require proper precautions.

All unsafe electrical equipment should be de-energized immediately and tagged "unsafe for use." This action and also notification of inoperable or damaged electrical tools, appliances, etc., should be reported to the immediate supervisor at once. Unqualified persons should not attempt to repair such equipment.

Under no circumstances should the hand or finger be used to test for voltage in a circuit. Only proper and safe test instruments should be used.

In case of an accident or an electrical fire, all power should be cut off immediately. Emergency switches are generally installed at convenient locations to stop electrical machinery. Know where these switches are. Use only fire extinguishers which have been approved for use on an electrical fire. Foamite or other conductive fluids, including water, must not be used on an electrical fire under any circumstances.

Electrical work of any kind will not be performed if an electrical storm is in progress in the immediate vicinity.

Adverse conditions such as darkness, poor weather, isolation, or any abnormal situations may make working alone unduly hazardous. These occasions should be identified by established management guidelines from which the employee can carefully assess the task to be performed and determine whatever assistance might be necessary to perform the job safely. All electrical conductors and equipment will be approved and meet the standards in 29 CFR Subpart K covering the electrical equipment and work practices for this project (copy follows).

13.0 SPILL PREVENTIVE/CLEANUP PLAN

All personnel involved on a project should be aware of all possible polluting situations and take steps to prevent such occurrences.

CSA Operations Managers will insure the MARPOL rules and regulations are posted on the vessel and are followed by all members of the survey team.

Should a spill occur, the following will be available:

- Absorbent pads for use on local spills on vessel and, if necessary, small discharges into the water;
- Absorbent booms for installation around drums and apparatus that could cause a spill on vessel;
- Should portable generators/winches be used that involve fueling, a catchment tray will be provided to prevent gasoline/oil or other fluids from being spilled;
- Shore personnel to locate suitable disposal container close to dock for trash removal from vessel; and
- Trash bags and ties for general trash storage will be provided on vessel.

In case of large spills, the vessel is to cease operations, stay in the area and call in to the local client base, local Coast Guard, or other appropriate regulatory agency.

PICK UP ANY TRASH YOU SEE -- NOT JUST YOUR OWN.
AND REMEMBER NO TRASH/DEBRIS/WASTE/POLLUTANT IS TO BE DEPOSITED ANYWHERE BUT IN THE CORRECT RECEPTACLE.

14.0 SHORT-TERM EMPLOYEE PROGRAM

Any CSA employees that have been with the company less than six months will be identified as "Short-Term Employees" to all personnel including the client or its agent prior to start-up and mobilization of project.

Short-term employees will be given a job-specific orientation prior to the general job safety meeting dealing with the client's site safety expectations and procedures and hands-on training by CSA for upcoming job assignments.

Short-term employees will expect to be given special supervision during their 90-day probationary period with the orientation reinforced at the end of their first week's employment with CSA and at the end of their first month's employment. The employee will then be evaluated by their supervisor monthly for the next three months. It is implied here and to be understood by the short-term employee that he will be teamed with an experienced employee whenever possible. Under no circumstances will two short-term employees be teamed on a job without approval.

APPENDIX

APPENDIX A

Hazards Analysis/Risk Assessment

HAZARDS ANALYSIS/RISK ASSESSMENT

Hazard	Consequences/Risk	Severity	Safeguard(s)/Control Measure(s)	Risk Matrix		Recommendations	Responsibility	Status
				Likelihood	Risk Rank			
Lifting accidents, dropped equipment	Injuries, damage to or loss of equipment/material	Major	Lifting procedures, lift plan, worker awareness, qualified/experienced personnel	Remote	B	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
Boarding/loading boats	Trips, falls, injuries, damage to or loss of equipment	Minor	Designated boarding/ loading areas and procedures, first aid, clear work procedures	Infrequent	A	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
Navigation and positioning control	Wrong locations, work delays, impact to work productivity	Moderate	Obtain latest nautical charts, set up and check CSA vessel GPS navigation during mobilization, prepare pre-plots, provide accurate locations, provide coordinates in a digital exchange file	Remote	B	Confirm accuracy of coordinates through backup GPS	Project Scientist	Open
Deployment/handling of sample collection equipment	Pinching injury, impact/crushing injury, entanglement, MOB	Moderate	Worker training, established procedures, work gloves, HSE briefing	Infrequent	B	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
Man overboard (MOB)	Loss of personnel	Major	PFDs, work deck rules, safety chain, MOB procedures	Infrequent	C	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
General health and safety (offshore/on water)	Heat exhaustion and overheating, exposure, dehydration, minor injuries	Moderate	Adequate drinking water available, sunscreen, light clothing, clear decks, designated work areas and clear work procedures, first aid	Infrequent	B	Review during HSE induction	Operations Supervisor	Open
Spillage of fuels, oils, and lubricants	Environmental degradation, regulatory fines, damage to reputation	Major	Refueling on land or in port only, adequate capacity for full-day operations	Infrequent	C	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
General health and safety (onshore)	Exposure, dehydration, minor injury	Moderate	Adequate shade, adequate drinking water available, sunscreen, light clothing, clear/designated work areas, clear work procedures, work breaks	Infrequent	B	Review during HSE induction	Operations Supervisor	Open
Road/driving accidents	Collisions, damage to vehicles or equipment, injury	Major	Use of licensed and experienced drivers, safe driving at posted speeds, seatbelts	Remote	B	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
Food-/water-/blood-borne pathogens	Debilitating illness, impacts to productivity	Moderate	Worker training, HSE briefing, emergency response plan	Infrequent	B	Review during HSE induction	Operations Supervisor	Open

Hazard	Consequences/Risk	Severity	Safeguard(s)/Control Measure(s)	Risk Matrix		Recommendations	Responsibility	Status
				Likelihood	Risk Rank			
Unsafe weather/sea state conditions	Damage to vessels	Major	Weather forecast reviews, continuous monitoring of local weather, ongoing communications, delay/cancel/abort weather thresholds	Remote	B	Conduct continuous monitoring of weather while on site, morning forecast reviews and postpone mobilization if predicted to exceed limitations	Operations Supervisor	Open
Rough sea conditions	Injuries, MOB, damage to or loss of equipment/materials	Moderate	Check for secure deck and equipment/materials before getting underway, use of PFDs	Infrequent	B	Cross check for clear deck prior to getting underway	Operations Supervisor	Open
Vessel mechanical failure or damage	Loss of vessel, vessel adrift, stranded divers	Major	Rigorous vessel maintenance and inspection, standby vessel, float plan, established communications	Remote	B	Ensure valid vessel inspections, pre-day vessel checklists	Vessel Master	Open
Unsafe deck conditions (e.g., wet, cluttered)	Slips, trips, falls, MOB, damage to equipment	Major	Clear decks, designated work areas, clear work procedures, emergency response plan	Frequent	D	Review procedures and PPE requirements in toolbox meeting prior to activity; install safety line across stern	Vessel Master	Open
Underwater obstructions, contact with bottom, grounding	Damage to seabed features/organisms, damage to boats/ equipment, injuries	Major	Review of nautical charts, mapping of navigation hazards, experienced boat operators	Remote	B	Review transit route for obstructions, shallow water	Vessel Master	Open
Other vessel/traffic shipping	Collisions	Major	Deck watch	Remote	B	Review of shipping patterns, contact any vessels in vicinity	Vessel Master	Open
Medical emergencies (injured/unconscious worker), limited timely medical access/support	Lack of/late medical attention leading to medical complications, possibly disablement/ fatality	Major	Emergency procedures for worker extraction, established communications to shore, standby vessel, local emergency support, emergency response plan, emergency oxygen on-board, comprehensive first aid equipment	Remote	B	Prior arrangements with Port/ambulance, advice to Navy and/or Coast Guard; post-emergency contact infomation readily available on all vessels/boats	Operations Supervisor	Open
Emergency preparedness	Inadequate response to emergencies	Minor	Conduct weekly drills, HSE inspection to review emergency systems	Infrequent	A	Review procedures in toolbox meeting prior to activity	Operations Supervisor	Open
Confined Space Entry	Loss of consciousness, fatality, impact to work productivity	Major	Real-time air monitoring, forced air ventilation, full body harness, rescue tri-pod	Remote	B	Review procedures in toolbox meeting prior to activity	Site Safety Officer	Open

APPENDIX B

MSDS for Project chemicals

Project Chemicals:

Liquinox

Isopropyl Alcohol

Hexane

COREXIT EC9500A

APPENDIX C

FORMS

Pre-Mobilization Safety Briefing

HSE Indoctrination Record

Job Safety Hazard Analysis

Hazard Analysis/Risk Assessment Acknowledgement

Daily Safety Meeting

Incident/Accident Notification

Next of Kin Information

Daily Survey Report

Management of Change Order

CSA INTERNATIONAL, INC.
PRE-MOBILIZATION SAFETY BRIEFING (PMSB)

A PMSB will be conducted by the CSA Site Safety Coordinator

The following is a summary of items to be discussed:

1) Description of project and goals
   - Sediment & Water collection, hydrographic profiler casts, ADCP, ROV Ops
2) Communications – key to acquiring goals
   - Accident prevention - safe and healthy environment
3) Team members, assignments, and shifts
   - CSA, NOAA, and vessel crew
4) Coordination with boat driver/vessel's crew
   - Efficient procedures
   - Emergencies - medical, fire, man overboard (MOB), abandon ship
5) Designation of person in charge on deck
   - Shift leader
6) Complexity of the operations
   - Mobilization, Field, Demobilization
   - Collection Processes
7) Pre-operation checks
   - Vessel preparation
   - Location of vessel safety equipment
8) Safety equipment
   - Vessel
   - Sampling
   - First-aid
9) Hazards
   - Vessel operations
   - Sampling operations
   - Vessel and equipment: slips, trips, falls, bumps, pinching;
10) Limitations of personnel and equipment
    - Lifting, rigging, and safe working loads
    - Personal protective equipment
11) Environmental conditions
    - Wind, sea state, etc.

The PMSB/HSE induction for all personnel involved with the field activities will be conducted prior to vessel mobilization. Daily briefings will be conducted for survey personnel. All vessel crew members will be briefed on the operation of all primary and support equipment and primary sampling equipment (especially the winch, blocks, cable, and A-frame) prior to mobilization. It is the responsibility of the survey team members to ensure that proper rigging and lifting procedures are used. The vessels' Masters will be responsible for conducting the following drills: MOB, fire, abandon ship, and medical emergency. These drills will be conducted once before the survey begins and weekly thereafter.

CSA INTERNATIONAL, INC.

HEALTH, SAFETY, AND ENVIRONMENTAL INDOCTRINATION RECORD

Name:

Date:

Employer:

I have received indoctrination and training for following:

1. Company safety policies of CSA, NOAA, and vessel safety requirements and the names of persons assigned to safety supervision duties.
2. Requirements and my individual responsibilities for accident prevention, maintaining a safe and healthy work environment, preventing damage to property, and protecting safety of others.
3. Provisions for medical facilities and procedures for reporting or correcting unsafe conditions and practices, and reporting accidents.
4. Job hazards and means used to control or eliminate those hazards, including applicable "Job Safety Analyses (JSA)" (major activity, locations, hazards, controls).
5. Accident Reporting - Both my individual and my Supervisor's responsibilities for reporting all accidents, even minor.
6. Sanitation - Water, toilet facilities.
7. Medical Facilities - Location of nearest medical emergency facilities, emergency phone numbers, first-aid kits and material data safety sheets.
8. Emergency Plans – man overboard, fire, medical, severe weather, spill response, and other emergency procedures.
9. Personal protective equipment.
10. Daily housekeeping requirements.
11. Fire prevention.
12. Policy on use of ropes, slings, and chains.

13. Hazards of floor and wall openings.
14. Hearing protection.
15. Requirements when working around hot substances.
16. Precautions with welding, cutting, and grounding of machinery.
17. Temporary electrical requirements.
18. Proper use of hand tools and power tools.
19. Proper precautions with compressed gas cylinders.
20. Requirements for ramps, runways, platforms, and scaffolds.
21. Clear access and ladder safety.
22. Material handling, storage, and disposal.
23. Hazardous materials.
24. If I am injured I (do) (do not) want the following person notified:

Name:

Phone:

Signature: _____ Date _____

Safety Officer Signature: _____ Date _____

CSA INTERNATIONAL, INC.

JOB SAFETY HAZARD ANALYSIS FORM

JOB TITLE:	JSHA No.____	Page___of___	DATE: New___ Revised___
Employer: Facility: Location:	Classification(s) Doing Job: Supervisor:	Required /Recommended Personal Protective Equipment:	Analysis by: Reviewed by: Approved by:

Sequence of Basic Job Steps	Potential Hazards	Recommended Action or Procedure

CSA INTERNATIONAL, INC.

HAZARDS ANALYSIS/RISK ASSESSMENT ACKNOWLEDGEMENT

My supervisor has reviewed this hazard analysis with me, and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so. I understand that there are Environmental, Safety, and Health professionals on staff if I need further assistance or clarification.

Name (please print)	Signature	Date

CSA INTERNATIONAL, INC.

DAILY SAFETY MEETING FORM

DATE:_____

PROJECT TITLE:_____

CONDUCTED BY:_____

IN ATTENDANCE: **Print Name** **Sign Name**

SUBJECT(S) DISCUSSED: **Potential Safety Hazards and Resolutions**

INCIDENT/ACCIDENT NOTIFICATION FORM Directions for filling out form

Email within 24 hrs to – Lynwood Powell, CSA Stuart Office – lpowell@conshelf.com

Originators Reference No: *Number assigned by project/asset as in its incident summary*		
Date of Incident:	**Time:**	**Exact Location**: **Location of the incident/Project Group**
Name of Person(s) involved: *Injured party, any other people involved*		
Employing Company: *Injured party and all people involved*		
Type of Incident: *LTI, Near Miss, RWC, Medical Treatment, etc.*		
Initial Potential Consequence: *Assign initial potential consequence as per The Risk Assessment Matrix*		
Description of Incident:	Where, when, what, how, who, operation in progress at the time (only factual)	
Provide details of the incident including: - *timing,* - *order of events,* - *Personnel involved their position, company, etc.* - *their role in the incident,* - *any relevant information available at the time of reporting* - *medical/emergency response details* - *any other important information*		

Immediate Action:	Immediate remedial action and actions to prevent reoccurrence or escalation
In this section provide only immediate remedial actions (corrective) and actions TO PREVENT REOCCURRENCE. Do not include medical response into this section	
Remedial Actions: *Provide long term remedial actions (if identified at the stage of reporting). For the incidents requiring further investigation do not include remedial actions. Those will have to be reported as a part of a final investigation report*	

Name: **Title:** **Date:**

Signature:

CSA International, Inc.

INCIDENT NOTIFICATION FORM

E-mail/Fax within 24 hrs to – Lynwood Powell, CSA Stuart Office – lpowell@conshelf.com

Originators Reference No:		**Project/Asset Group:**
Date of Incident:	**Time:**	**Exact Location**:
Client/Employing Company:		
Type of Incident:		
Initial Potential Consequence:		
Description of Incident: Where, when, what, how, who, and the operation in progress at the time (only factual).		
Immediate Action: Immediate remedial action and actions to prevent reoccurrence or escalation.		
Remedial Actions:		

Name: **Title:** **Date:**

Signature:

CSA International, Inc.

NEXT-OF-KIN INFORMATION

[redacted]

CSA INTERNATIONAL, INC.
DAILY SURVEY REPORT

Client: NOAA
Project: Water Column Profiling Survey
Location: GOM; MC Block 252
Job Number: CSA-2290
Date:

Vessel:
Client Rep:
Current location:
Satellite Phone #:
Onboard Email:

Weather Report
Wind speed/dir:
Wave height:
General:

PERSONNEL ON BOARD

CSA	*Client*	*Vessel*

CSA INTERNATIONAL, INC.
Daily Survey Report (*Cont'd*)

SAMPLE SUMMARY

Total Stations:		Total Stations:	
# Complete:	0	# Complete:	0
% Complete:	0.00%	% Complete:	0.00%

DAILY ACTIVITIES LOG

Time	*Description*

SUMMARY OF PROJECT TIME

Operation	*today*	*previous total*	*Total*
Mob/Demob			0
Operations			0
Standby Weather			0
Standby Other			0
Standby in Port			0
Standby Client			0
Technical Downtime			0
Vessel Downtime			0
Maintenance Time			0
TOTAL	0	0	**0**

CSA INTERNATIONAL, INC.
Daily Survey Report (*Cont'd*)

PLANNED ACTIVITY FOR NEXT 24 HOURS

ACCIDENTS/INCIDENTS

HAZARDS REPORTS

AUDITS COMPLETED

SIGHTINGS OF/INTERACTIONS WITH FISHERMEN

EMERGENCY DRILLS COMPLETED

HSE ISSUES/CONCERNS

MARINE MAMMAL/SEA TURTLE SIGHTINGS

CURRENT ESTIMATE OF COMPLETION DATE

CSA INTERNATIONAL, INC.
Daily Survey Report (*Cont'd*)

MONTHLY EVENTS

Event	*Quantity*
Number of Fatalities	
Number of Lost Time Injuries	
Number of Restricted Work Injuries	
Number of Medial Treatment Injuries	
Number of First Aid Injuries	
Number of Fires and Explosions	
Number Incidents involving Equipment Damage	
Number of Near Misses	
Number of Spills (to sea or land)	
Number of Security Incidents	
Number of hazard reports /STOP cards or safety observations	
Number of incidents involving stakeholder complaints	
Amount of waste generated, categorized by type. (monthly only)	
Amount of fuel oil / diesel used	

At the completion of the survey a report on injury absences and details of ongoing HSE Programs/Initiatives will be completed.

CSA INTERNATIONAL, INC.

Management of Change Order

Date:

To:

Subject:

Comments:

Project Change	Reason for Change

Approved by:

CSA Project Manager

_____

Client Representative

_____

MC 252 Standing Order

TO: All Personnel assigned to MC252 Response		
FROM: Tad Lynch	POSITION: Houston IC Safety Officer	
SUBJECT: Incident Reporting	DATE: 02 May 2010	Time: 1630 hrs

1.0 PURPOSE AND SCOPE

The purpose of this Standing Order is to establish a consistent HSSE incident reporting process for MC252 response personnel. Response personnel include all Federal employees, BP employees, Contractors, Visitors, and other third parties. These minimum reporting requirements are for response operations and are not intended to replace site or project-specific incident and emergency response procedures and policies. The ultimate purpose is to enable and foster a culture of sharing and continuous improvement through identifying trends, special focus needs, case management, HSSE performance and sharing lessons learned.

2.0 RESPONSIBILITIES

All personnel involved in the MC 252 response who are personally involved in, or witness an incident or near miss; are required to immediately notify the person in charge or BP Supervisor who is responsible for the work being conducted. The person in charge or BP Supervisor is responsible for making timely notifications to the appropriate Incident Command or Unified Area Command - Safety Officer (currently Houma, Houston, Mobile, and Robert).

Robert SO (985) 709-5522 **Houma SO (985) 493-7812**
Houston SO (281) 366-6916 **Mobile SO (251) 445-8690**

3.0 NOTIFICATION REQUIREMENTS

Incident Classification	**Notification Time**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Immediately
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment), First Aids, or Near Miss	Within 2 hours

4.0 REPORTING STRUCTURE

Safety Officers and/or Health & Safety Unit Leaders are required to report all incidents and near misses to the Safety Officer in Robert, La. - **(985) 709-5522.** After verbal notification has been made, send written incident reports and associated documentation to *MC252Safety@bp.com*.

Input into Traction will be completed by an HSSE Technician in Houston. The Tech will access information via the above e-mail location.

NOTE: If you are a Safety Officer and are not on the MC252Safety@bp.com distribution list, contact the number above and they will submit your information to IT&S to get you set up.

5.0 REQUIRED INFORMATION

Instructions: The Initial Incident Report should be completed using the attached GoM Preliminary HSSE Incident Report "Short Form", or an equivalent contractor supplied form. At a minimum, information should include the following and sent to *MC252Safety@bp.com*.

C:\Documents and Settings\churchtr\My

Minimum information to include:

Report Date:
Date / Time Occurred:
Date / Time Reported:
Type of Incident: First Aid, Recordable, Near Miss, Spill, HIPO, MIA
Location (Circle One): Offshore or Onshore
Site / Vessel:
Company/Agency/Volunteer Group involved:
Event Description:
Completed by:
Contact Phone #:

6.0 INCIDENT INVESTIGATION

The level of investigation performed will depend on the actual and potential severity outcomes. The level of investigation and responsible organization are listed below.

Incident Classification	**Investigation Requirements**
Major Incident (MIA), High Potential Incident (HiPo), or Loss of Primary Containment (Spills)	Houston Safety Officer and Tim Church will determine level of investigation and team make-up.
Recordable Injuries (DAFWC / Restricted Duty /Medical Treatment),	Local investigation. One-page Lessons Learned document will be developed by Tim Church from local investigation report.
First Aids, or Near Miss	Local investigation. Incident report containing information outlined in Section 5.

7.0 HSSE PERFROMANCE SCORECARD

The Safety Officer in Robert will report incidents to the Unified Area Command BP Liaison and BP Aide de Camp. They will also update and distribute the HSSE Performance summary and scorecard daily by 1100 hrs. It is responsibility of each IC Safety Officer to distribute the information to appropriate command and planning staff.

Safety Officer Name:	Date:
Signature:	Approval Signature:

Transfer of Personnel and Material at Sea

Purpose

This protocol applies to vessel operations involving the joint research being conducted aboard the Entrix/CSA research vessels in conjunction with the MC -252 Deepwater Horizon Spill Response efforts.

The type of water sampling being conducted on this mission requires lab analysis ashore of samples within 7 days from the time they are taken. Sample degradation occurs rapidly, necessitating supply vessels to recover these samples within 72 to 96 hours of collection from the sampling vessels or at other regular intervals on extended missions. Other supplies including food, equipment or spare parts may be transferred also. In addition to samples and supplies, personnel issues may require transfer of personnel from one vessel to another. These circumstances may arise from a medical emergency or other significant personal issue. This protocol is to provide safety guidance when conducting these operations at sea. This protocol is designed to apply to operations where the following conditions are true:

1. A vessel or vessels need supplies, equipment or spare parts,
2. A vessel or vessels need to discharge samples
3. Items to be transferred consist of scientific supplies to support the mission.
4. Personnel emergencies

For the purposes of this mission, all materials to be transferred are items that can be carried by 1 or 2 people. The bulk of these supplies include scientific equipment, water samples and personal effects. These rules do not apply to visitors to the ship including press, family members and USCG boarding personnel.

Application

It is the ultimate responsibility of the Master of each vessel involved to ensure the safety of all personnel involved in the operation. The Master of either vessel shall call off the operations if he or she believes it to be unsafe for any reason. Nothing in this protocol relieves the Master of this responsibility. The Master's judgment shall take into account (but is not limited to) the following factors:

1. Sea conditions
2. Weather conditions
3. Vessels involved
4. Crew fatigue
5. Crew experience
6. Equipment
7. Type and quantity of material to be transferred

This operation, except in the event of an emergency, shall not be conducted in the following conditions:

1. Night,

2. Restricted visibility,
3. Where traffic proximity is cause for concern and may involve a risk of collision,
4. Over a World Meteorological Organization (WMO) sea state of 3,
5. Where transferring goods at the dock is possible and practical,
6. Communications between the 2 vessels has not been established,
7. Where the Master of either vessel has any doubt.

Procedure

All at sea transfers shall be conducted only in daylight and at the discretion of the Master.

The method of approach shall be agreed upon by the Masters of both vessels. It is the choice of the Master to select the approach that is safest with regard to vessel type, configuration, fendering, deck height, vessel maneuverability as well as any other factors which may affect the operation. The operation described herein is common practice for such operations and shall be regarded as the default plan for all such operations.

Communication via VHF radio will be established and maintained throughout the entire operation.

The wheelhouses of both vessels shall be manned during the entire operation.

One individual aboard the Vessel other than the person(s) manning the wheelhouse shall supervise the operation on site and be in communication with the Vessel wheelhouse.

One individual on the Vessel shall be designated to stand by the transfer site with a life ring at the ready in the event of a man overboard. This individual will also be equipped with a radio.

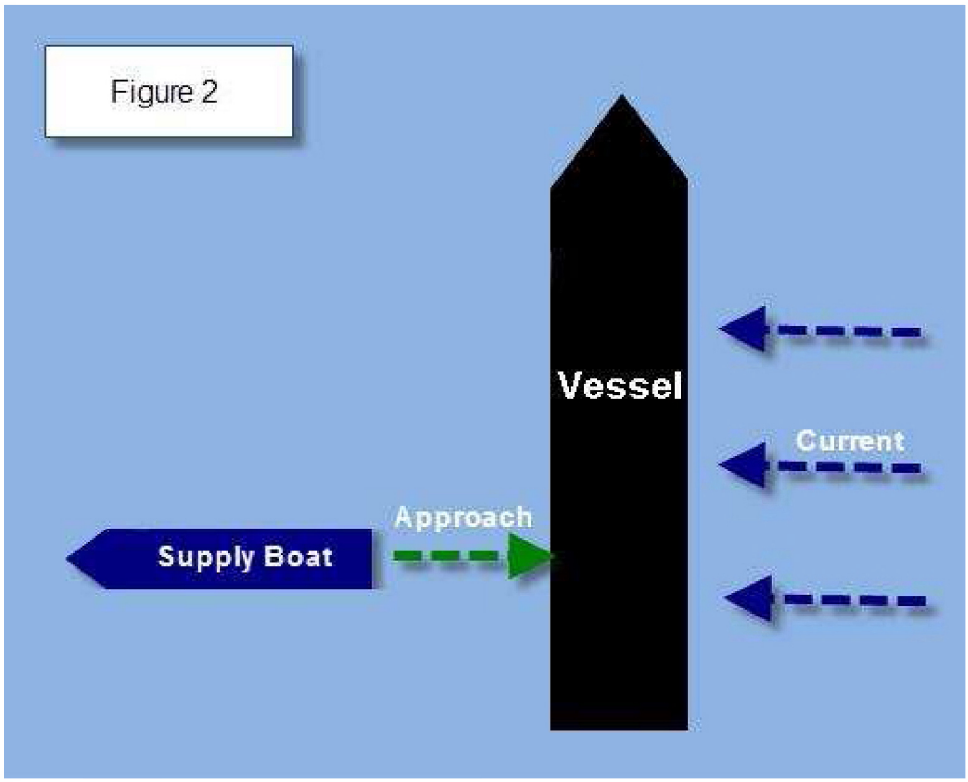
The Vessel shall, where practicable, be positioned in such a manner as to provide a lee and shelter the pilot boat from wind and waves.

The Vessel shall load from her aft deck either port or starboard side where the break in the gunwale provides the best access to the waterline with the least freeboard to the deck as shown in Figure A.

The vessel shall make no way as the supply vessel approaches.

The supply vessel will make contact with her centerline perpendicular to the hull of the Vessel (see fig. 2).

The supply vessel, where properly fendered, shall approach the Vessel down current and stern to (see fig 2).



Contact between the vessels shall be made while coasting at a safe and minimal speed. Forward propulsion by the supply boat may be used to slow the approach. If during the approach the docking angle is lost, the vessels shall reposition where safe and appropriate for another attempt.

No lines or entanglements shall make fast one vessel to the other.

If the vertical distance between the 2 decks used in the operation on either vessel is greater than 12 inches, then a pilot ladder or other approved boarding equipment shall be used.

Material shall be transferred in a slow and deliberate manner.

If a crane is available, all materials shall be handed across using the crane to move materials from one vessel to another.

Other than in an emergency, vessels will break contact only under the following conditions:

1. The supervisor has ensured all personnel are in a safe position to break contact,
2. The pilot ladder has been recovered,
3. The Masters of both vessels involved agree to end the operation,
4. It is safe to do so.

PPE

All personnel on deck must wear an approved buoyant work vest.

All personnel involved in the operation on deck shall wear an approved hard hat, safety glasses, long pants and closed toe shoes/steel toe shoes where company safety regulations apply.

Requisition

At sea transfer missions shall be requested prior to the Vessel's departure from the port and incorporated into the vessel's mission planning.

Emergency

Nothing in this protocol shall prevent the master of either vessel from taking action in an emergency. This protocol governs only routine scientific supply transfers. The ability of the master to transfer personnel, stores or equipment in a safety or medical emergency shall not be infringed.

Offshore Reporting Procedures for the MC252 NRDA Scientific Fleet
Updated 7/13/11

All NRDA Scientific Vessels must supply information regarding cruise operations 48 hours prior to departure as well as daily during cruises.

1. Provide information on cruise and equipment 48 hours prior to departure.

Inform the following individuals via e-mail of your anticipated departure time, closest point of approach to the MC-252 wellhead, nature of activities, general equipment to be used, and the make, model, and frequency of any acoustic devices to be employed. E-mail subject line should be "[Vessel Name]: Pre-departure Contact" and should be sent to:

chad.smith@darkwatermarine.com	Joint NRDA Vessel Operations Coordinator (NOAA Rep)
jodi.harney@cardno.com	Vessel Committee (Cardno ENTRIX Representative)
dwhnrdafieldops@gmail.com	NOAA/Trustee Distribution List Manager

2. Submit Daily Situation Reports ("SITREPs").

Prior to departure, begin submitting a Vessel Situation Report (form provided in PDF format) by 0800 daily. E-mail subject line should be "[Vessel Name]: Daily Vessel SITREP [Date]" and should be sent to:

chad.smith@darkwatermarine.com	Joint NRDA Vessel Operations Coordinator (NOAA Rep)
jodi.harney@cardno.com	Vessel Committee (Cardno ENTRIX Representative)
dwhnrdafieldops@gmail.com	NOAA/Trustee Distribution List Manager

Safety Information

1. Acoustics

When using acoustic devices, please consult with the best management practices for avoidance of impact to marine mammals (separate attachment). Acoustic devices include echo sounders and USBL, ADCP, and multibeam systems.

2. Vessel-to-Vessel Communications

At present, there is no required call-in for vessel operating in the field.

3. MC-252 Wellhead Access and Hazard Avoidance

There is a court-ordered exclusion zone around the wreckage of the Deepwater Horizon located near the MC-252 wellhead (position 28° 44.483' N, 88° 22.050' W). No vessels are permitted within 750' of this location. Other mapped and unmapped hazards may exist in the water column and on the seafloor in the area. Navigators from Continental Shelf Associates (CSA) on board NRDA fleet vessels will be supplied with the location and nature of known, mapped hazards.

Definitions

1. NRDA Vessel Coordination Committee

A group which coordinates the needs of offshore vessels, proposed cruise plans, and vessel operations. The committee includes representatives from BP, Trustees, CSA, and Cardno ENTRIX. A conference call is held every Monday at 1530 CDT.

Offshore Reporting Procedures for the MC252 NRDA Scientific Fleet
Updated 7/13/11

Contacts

Name	Role, Affiliation	Email	Phone
Graham, Eileen	Project Scientist, ASA/NOAA	egraham@asascience.com	(443) 745-5323
Harney, Jodi	Project Scientist, Cardno ENTRIX	jodi.harney@cardno.com	(813) 373-8479
Mulcahy, Bob	Operations Lead, Continental Shelf Associates	rmulcahy@conshelf.com	(561) 758-7152
NOAA NRDA Field Ops	Trustee Logistics	dwhnrdafieldops@gmail.com	(504) 410-7787
Smith, Chad	Joint NRDA Vessel Operations Coordinator, NOAA Rep	chad.smith@darkwatermarine.com	(617) 999-4163

DWH Vessel Daily SitRep

Vessel Name: | In Port ○ | Underway ◉ | Date:

Next Port of Call: | ETA/ETD:

Current Position: | Time (24 hr):

Latitude: | Longitude:

Cruise Plan Title:

Current Operations:

Operating within 15 NM/28 km of Wellhead? YES ◉ NO ○

If yes, list acoustic instrumentation onboard and frequencies used.

Operational Issues:

Additional Comments:

Submitted by:

Email daily by 0800 to:
chad.smith@darkwatermarine.com (Vessel Ops)
dwhnrdafieldops@gmail.com (Trustee Rep)
jodi.harney@cardno.com (BP Rep)

Deep Benthic Communities and Water Column Ephemeral Data Collections:
Deepwater Horizon Oil Spill (DWHOS)
ROV Benthic Flocculent Collection
March 21, 2010

Flocculent Sampling Methodology:

Slurp Sampling

A suction sampling device (Figures 1-3) will be mounted to the ROV for collection of flocculent material at the sea floor. This slurp system consists of three components: a variable speed, hydraulically-powered suction pump, a rotating carriage containing six in-line filter cartridges plus a seventh empty chamber for system flushing, and a suction tube. The pump sits near the rear of the ROV and draws water in from the suction tube located at the front of the ROV, by way of one in-line filter. The manipulator arm of the ROV will be used to guide the tip of the suction tube into the floc sample on the bottom (with on-board control and direction through the real-time video feed in the ROV shack and survey trailers), and any particulate matter will be drawn into the suction tube and retained by the in-line filter while the water is drawn through the filters and into the pump. The carriage containing the six filter cartridges is rotated by the manipulator of the ROV to bring a new filter cartridge in-line and seal-in the previous sample. Each in-line filter contains both a pre-filter (stainless steel mesh, nominal pore size 25 μm) and a primary filter (2.7 μm nominal pore size GF/D glass fiber filter) in series.

Slurp samples will be collected at each station where coring is conducted and at up to two additional locations on each seafloor transect of the ROV. Slurp sampling will target benthic flocculent which is difficult to collect by coring and other methods, and will occur at each station after a water sample has been collected, and before coring takes place. To collect each sample first the tubing will be cleared by moving the rotating carriage to the open (seventh) position such that free flow is allowed from the collection tubing to the pump. The carriage will then be rotated to the appropriate position containing the desired filter and seawater will be drawn through the system in order to purge out the existing water. The suction tube will then be placed near the benthic floc with the flocculent material drawn through the tube and trapped by the filter. The carriage is then rotated again by the manipulator arm of the ROV thus sealing the sample. This procedure is repeated for each station.

Slurp Samples for Chemical Analysis

On deck in the ship's laboratory, slurp samples will be drained of excess liquid in such a fashion that the particulate matter will be retained in the filter without agitation and loss of flocculent. Ideally the excess liquid will be drawn from the bottom of the filter cartridge such that the particulate matter is effectively retained. Once drained of water, the filters will be removed from the cartridge with tweezers, folded, and both filters placed together in a 500-mL wide-mouth jar. The two filters constitute

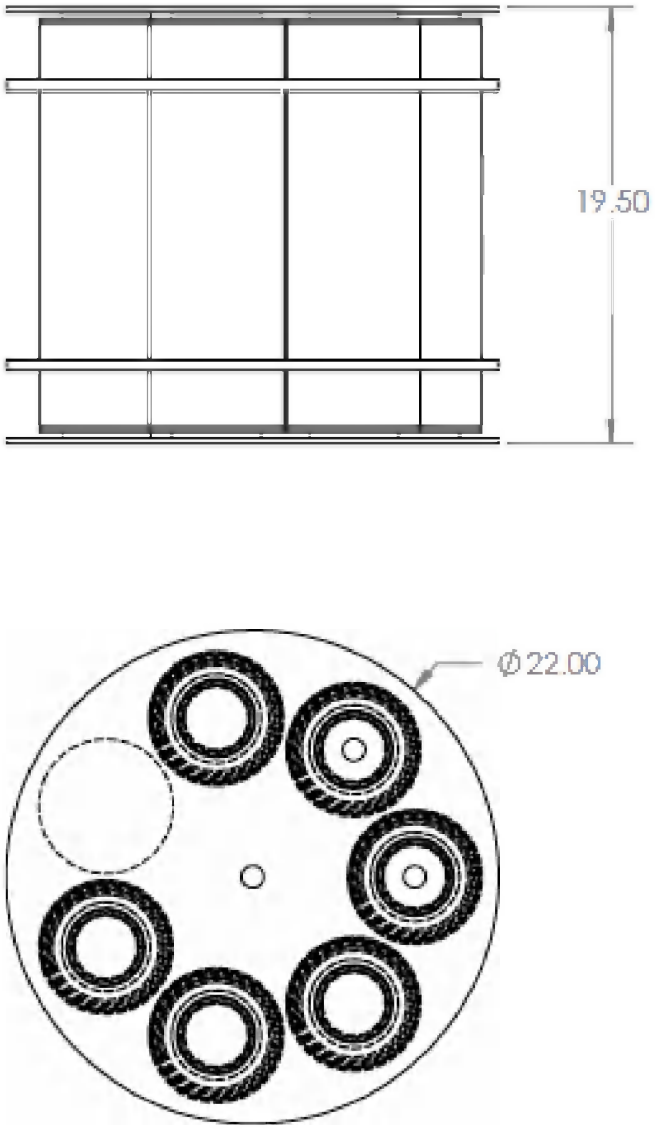


Figure 1. Side and top view of seven-slot Slurp Chamber for floc sampling (dimensions in inches; outside diameter of each sampling tube is 6 in.).

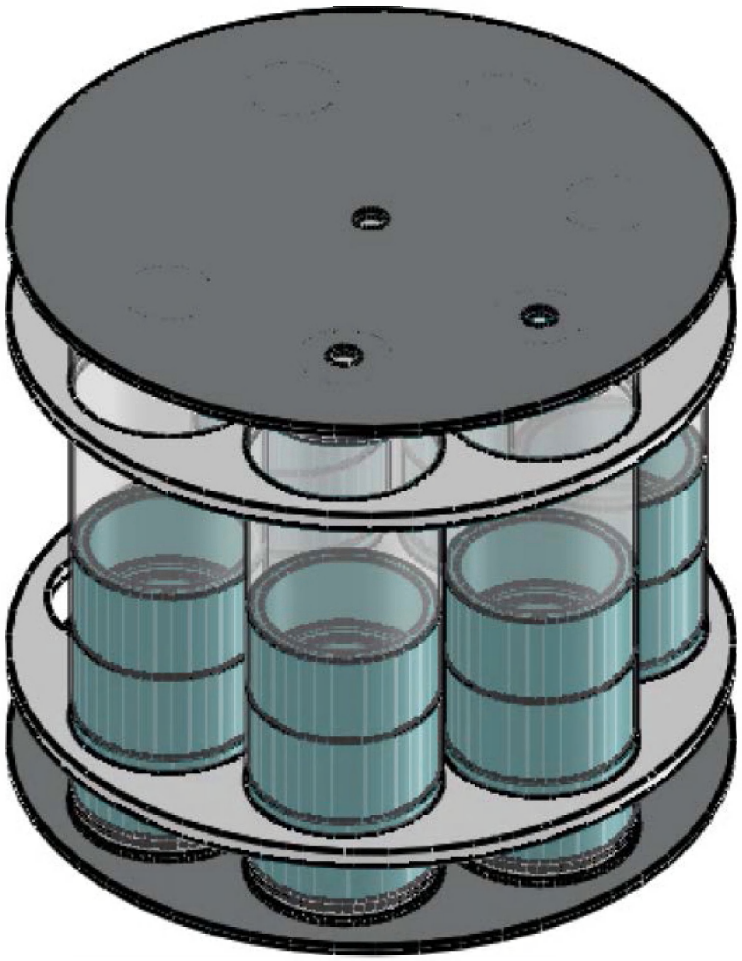


Figure 2. Perspective view of Slurp Cylinder showing placement of filter cups in six of seven chambers. Each filter cup will be fit with a 25 µm stainless steel filter at the bottom of the cup to support a 2.7 µm glass fiber filter. The holes in the top plate will be aligned with the sample chamber to allow water to be pumped through the chamber trapping the sample on the filter. The cover plate will be equipped with a Viton gasket to seal the chambers as they rotate into position.

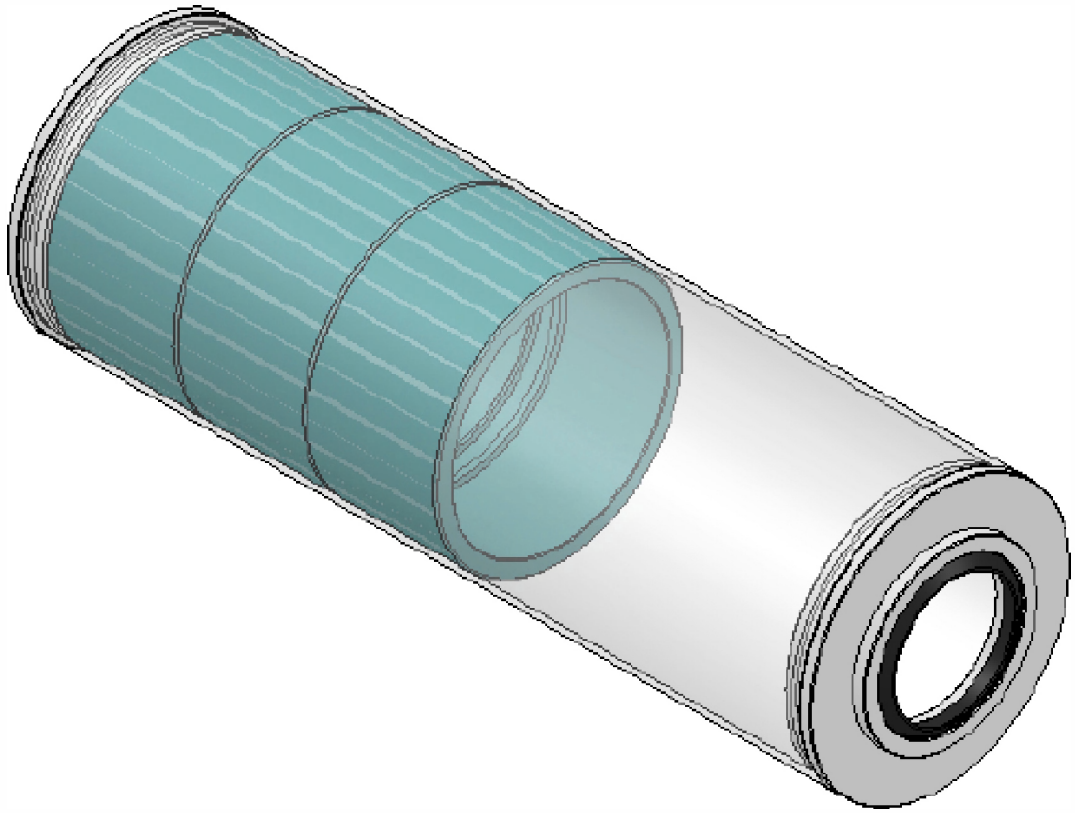


Figure 3. Close up of sampling chamber containing the filter cups inserted to trap and contain particulate floc. The end caps will be screwed into the top of each tube and be held in place in the revolving cylinder by a pressure spring outside the overall canister. All materials will be fabricated of materials compatible with decontamination washes using Alkonox and solvents such as methanol and hexane.

the sample. Filters will be kept frozen until shipment to Alpha Analytical for detailed chemical analyses and fingerprinting.

Sampling Equipment Decontamination

Decontamination of the slurp gun will be carried out by washing the equipment with soap and water on board the HOS Sweetwater between uses. Tubing, chambers holding the filter cartridges, and support backings for the filters will be rinsed with fresh water from the vessel followed by distilled water, and then purged with seawater at depth immediately prior to sample collection.

Sampling equipment visibly stained with oil or other hydrophobic material will be further decontaminated before use to minimize cross-contamination. While performing the decontamination procedure, phthalate-free gloves, such as Nitrile, will be worn. Sampling equipment will be decontaminated in the area designated for decontamination.

The decontamination procedure will proceed as follows:

- Wash and scrub tubing, filter chambers and cartridge holders with detergent
- Tap water/distilled water rinse
- An acetone (or methanol) only rinse (solvents must be pesticide grade or better) with an optional hexane rinse if necessary after contact by the equipment with visibly contaminated media that prevents complete decontamination at trace levels using the standard procedure.
- Thorough de-ionized (analyte-free) water rinse (if available; otherwise use distilled water)

Sampling equipment being used to collect samples for polycyclic aromatic hydrocarbon (PAH), total extractable hydrocarbon (TEH), or volatile organic carbon (VOC) analyses will utilize the methanol rinse.

Solvents used during decontamination activities (e.g., methanol, acetone, hexane) will be collected and handled in accordance with the procedures outlined in the Vessel Safety Plan.

On-Board Sample Handling and Storage

Flocculent samples will be treated as sediment, and analysis will be by methods and for analytes described in the MC252 Analytical Quality Assurance Plan Version 2.2, Section 1.0 (Attachment 8). These are:

- Analysis and reporting for PAHs including alkyl homologues by gas chromatography/mass spectrometry using selected ion monitoring (GC/MS-SIM). The analytical procedure is based on EPA Method 8270D with the GC and MS operating conditions optimized for separation and sensitivity of the target analytes. Alkyl PAH homologues are quantified using a response factor

assigned from the parent PAH compound. Analytes, associated response factors and target detection limits are listed in Table 1.1a of the MC252 Analytical Quality Assurance Plan Version 2.2

- Analysis and reporting for saturated hydrocarbons by gas chromatography with flame ionization detection (GC/FID) based on EPA Method 8015. Analytes and target detection limits are listed in Table 1.1b.
- Acquisition of data by GC/MS-SIM for petroleum biomarkers listed in Tables 1.1e and 1.1f.

Total organic carbon (TOC) will be analyzed if sufficient flocculent is collected. Alpha Analytical has indicated that TOC can be analyzed with as little as 1g of sediment sample, but 5g is preferable.

Deep Benthic Communities and Water Column Data Collections:
Deepwater Horizon Oil Spill (DWHOS)
ROV Benthic Biota Collection
July 29, 2010

***ROV Megafauna Collection*:**

Red crabs, *Chaceon quinquedens*, as well as other megafauna (including, but not limited to: squat lobsters, holothurians, worms, and other biota) will be collected opportunistically using the robotic arm of the ROV. The objective of this megafauna sampling is to document potential exposure to spill-related contaminants, including hydrocarbons (including PAH alkane series), metals[1], and dispersants.[2] Additionally, a subset of tissues will be collected for histopathalogy. Tissue analyses from samples collected on both the *HOS Sweetwater 4&6* cruises and the proposed red crab trapping survey to be conducted in late July to August 2011 on the *Pisces* will supplement the very limited existing samples of benthic biota collected from deepsea habitats for assessing exposure to spill related contaminants.

Megafauna Collection:

Whole organisms will be collected and transferred to mesh baskets on the ROV for transport to the surface. Each of the mesh baskets will hold animals collected from discrete locations that can be associated with sediments collected in the vicinity of where the animals are caught. Upon arrival at the surface, collected megafauna will be placed immediately in a refrigerated seawater system (Frigid Units, Inc) maintained at 5°C. Organisms will be given an identification number using an external carapace tag, if possible; or will be segregated individually to ensure identification. All organisms will be maintained alive in refrigerated seawater until dissected. Megafauna that arrive at the surface dead or die in the seawater system will be prioritized for dissection.

Sample collection forms will include sample identification numbers, vessel name, date, location geographical coordinates, method of collection, name of the individual collecting the animal, and other relevant observations (specifically including, but not limited to: presence of visible oil, status as live or dead, and general appearance of animal health). Biological data to be recorded on each crab will include: carapace width and length (mm), weight (gm), sex, molt stage, missing appendages, egg color (ovigerous females) and general appearance. Molt stage

[1] Metals that will be analyzed will include any metals associated with drilling muds as well as metals, the exposure to which might be anticipated under baseline. These include: Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, and Sr. The goal of measuring this suite of metals (beyond those that are common constituents of drilling muds) is to evaluate any potential confounding toxic effects such metals may have. Pre-release baseline metals concentrations in red crab tissues are available in Perry et al. (1998).

[2] Limited pre-release baseline metals and PAH concentrations in red crab tissues sampled in the vicinity of offshore drilling rigs are available in CSA (2006).

will be determined by external characteristics (hardness of shell and color). Similar measurements and observations will be made on other megafauna, if possible. Such data provide information on the general health and condition of the collected biota.

NOAA NRDA chain of custody procedures will be followed for transfer of samples from the vessel to the designated analytical laboratory. All appropriate health and safety guidelines will be followed.

Collection Tissue Samples for Exposure Analysis:

Organisms will be dissected onboard the vessel for visual observation and preservation of tissues. Prior to dissection, the dorsal and ventral side of each organism will be photographed along with their identification number, and the whole organism weighed. Dissections will be performed in an enclosed work space to minimize the chance of contamination of the tissues with exhaust from the vessel. In some cases whole organisms may be bagged and frozen for subsequent dissection and/or tissue analysis back at the laboratory. The decision about whether or not to perform dissections, as opposed to collection of whole organisms will be made by the fisheries biologist on board the vessel, based on his or her expertise of the organism of interest. Priority will be placed on collection of tissues for analysis of hydrocarbons, metals, and dispersants (in that order). A flow-chart for sampling is included below (Figure 1).

Organisms will be dissected on a glass cutting board using ceramic or teflon instruments. Dissection equipment will be decontaminated between each organism. Once the carapace is removed, the internal organs will be photographed to determine gross ovarian condition (see below). The following tissues will be excised: gills , hepatopancreas, gonads, and muscle. Care will be taken to avoid digestive tract tissues. If ovigerous females are collected, a sample of the egg mass will be taken. Sub-samples will be taken for histological analysis (see below). Tissue samples for contaminants exposure analysis will be weighed (if sea conditions permit) prior to being placed in a labeled, trace-clean jar and frozen onboard the vessel at -20°C. Target masses for analyses are the following: 30 g for hydrocarbon analysis, 5 g for metals analysis, and 10 g for dispersant analysis.[3]

Equipment blanks of the dissection work area and the refrigerated seawater system will be collected daily. Equipment blanks will be collected with the following procedures:

[3] With the exception of egg samples, samples for hydrocarbon, metals, and dispersant analyses will be alliquoted on board. Egg samples designated for contaminants analysis will be sent in an individual sample jar, and will be alliquoted at Alpha Analytical Laboratory.

- The refrigerated seawater system and all dissecting tools, including the cutting board and instruments will be decontaminated with Alconox, solvent (e.g., methanol), and water.
- The tools and cutting board and equipment will be rinsed with and laboratory-grade de-ionized water.
- The rinse water will be collected and stored in a sterile sample bottle and submitted to the laboratory for analysis of PAHs, hydrocarbons, dispersants and metals.

Samples for hydrocarbon analysis will be sent frozen to Alpha Analytical Laboratories. To the extent that low-mass analytical techniques become available for use in the NRDA (i.e., TOF-DART), low-mass analyses may be used to assess hydrocarbon content. To the extent that collected samples do not meet minimum sample mass requirements, individual samples may be composited at the laboratory for analysis. The following measurements will be made: total petroleum hydrocarbons (TPH), also referred to as total extractable hydrocarbons (TEH), representing the total aromatic and aliphatic hydrocarbon content of the sample; PAHs including individual parent and alkyl homologues; and saturated hydrocarbons including alkanes and isoprenoids. Hydrocarbon analysis of gill tissues will include the parameters above, as well as biomarkers used in petroleum hydrocarbon fingerprinting analysis. Egg samples sent to Alpha Analytical Laboratories will be enumerated using a "wet method" prior to analysis for contaminants to complement fecundity measures (see Objective 2 below). Specifically:

- The full egg sample will be thawed and weighed to the thousandth of a gram,
- A subset of 250 eggs will be counted and reweighed, and
- The total number of eggs in the full sample will be calculated using the egg-to-mass ratio of the 250-egg sub-sample.

The full egg sample including the sub-sample will then be subdivided into used for subsequent chemical analyses.[4]

Collection of Tissue for Histopathology Analysis:

Sub-samples of each tissue collected for exposure analysis above will be collected for histological analysis. Tissue subsamples will be excised and preserved on board in Bouin's Fixative, if available, or modified Davidson's Fixative. Upon return to shore, with the exception of egg samples, tissues will be processed by personnel at the National Oceanic and Atmospheric Administration Northwest Fisheries Science Center (NOAA NWFSC) using standard histological

[4] For the egg samples, the sub-sample for dispersant analysis will be refrozen and shipped to Columbia Analytical Services for extraction and analysis. Sub-samples for metals and hydrocarbons will be extracted and analyzed at Alpha Analytical Laboratory immediately after enumeration.

procedures: dehydration, clearing and embedding (Yevich and Barszcz 1977). Sections will be cut and the resulting slides stained in hematoxylin and eosin. Histological analyses will focus on tissue pathologies, including lesions.

Reproductive Histology:

As noted above, once the carapace is removed, the internal organs will be photographed to determine gross ovarian condition (immature, early, intermediate, advanced, mature, redeveloping/spent) using the methods of Haefner (1977) and Erdman (1990). Then, ovarian tissues will be sampled from all collected female crabs.[5] Although, as noted above, histological slides of any collected ovaries will be prepared at NOAA NWFSC, processed ovarian slides will be sent to Dr. Robert Erdman and compared to similarly prepared slides of red crab ovaries from the eastern GOM from the late 1980s. All other histological slides will be read by certified histologists at either NOAA NWFSC or NOAA Alaska Fisheries Science Center (AKFSC).

For ovigerous females, the egg mass will be removed from the pleopod and subsampled for reproductive assessment by personnel at NOAA AKFSC. Presence and color of extruded eggs will be recorded. Subsampling will be conducted to assess staging, morphometry, and fecundity (Attachment 1). Fecundity will be determined for each individual using published methodologies (Hines 1988). Because only a sub-set of eggs will be sent to NOAA AKFSC for fecundity determinations (with some eggs being sent to Alpha Analytical Laboratories for PAH analyses) fecundity will be calculated by summing the numbers of eggs enumerated through enumeration at NOAA AKFSC and Alpha Analytical Laboratories.

[5] The ovary is H-shaped in form and sections will be taken from the left anterior portion of the H, the right lower portion of the H and from the connecting portion.

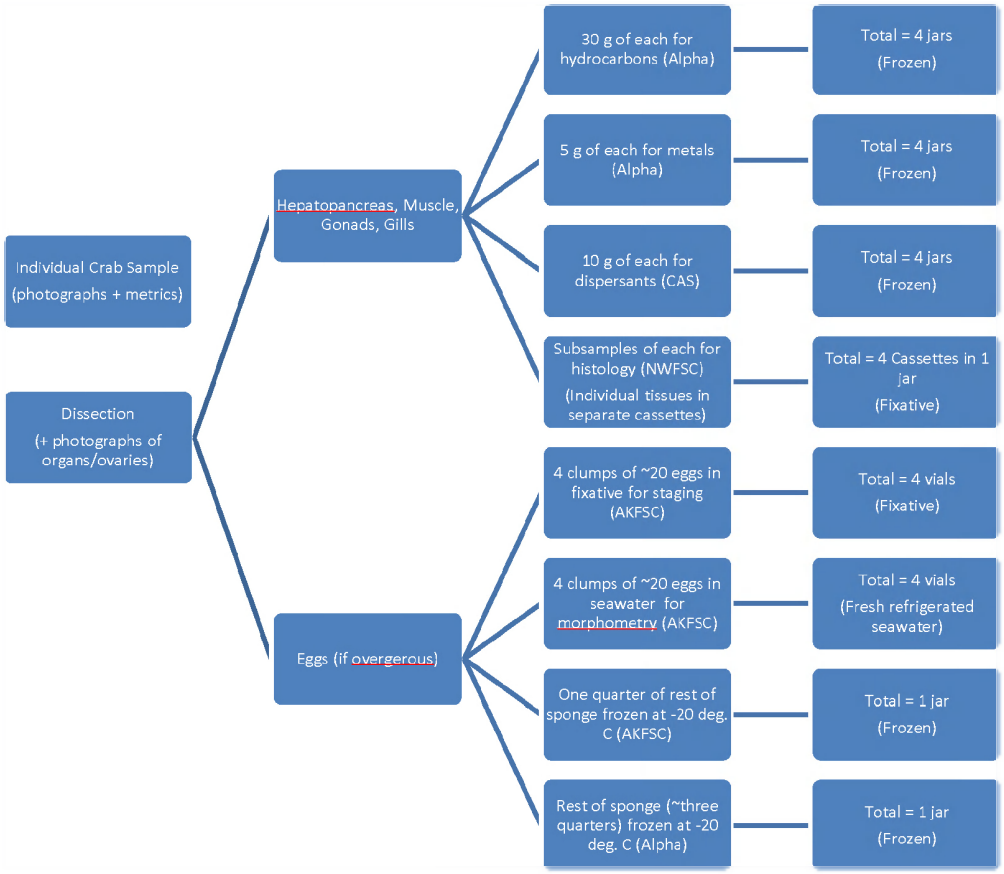


Figure 1: Sampling Flow-chart

Below is the protocol for characterizing the status and condition of crab eggs, including egg staging, egg morphometry, and fecundity. To prepare for sampling the crab eggs the abdominal flap (with eggs) should be removed by cutting the flap along the base of the shell making sure no eggs are lost. Eggs may then be removed for each method below:

Egg Staging:

Randomly sample 4 egg clumps (with ~20 eggs each) from different locations around the clutch with forceps. Each egg clump should be removed and immersed in a separate vial of Bouin's solution, if available, or Davidson's Fixative. Embryo developmental stages will be determined using a compound microscope with approporiate magnification to identify developmental stages (Moriyasu and Lanteigne 1998).

Egg morphometry:

Randomly sample 4 egg clumps (with ~20 eggs each) from different locations around the clutch with forceps. Each egg clump should be removed immersed in a separate vial of seawater with

1/3 eggs, 1/3 seawater, 1/3 headspace. Vials must be kept chilled and seawater replaced every 2 days while at sea and examined under a dissecting microscope immediately upon arrival to the laboratory. If the samples do not get analyzed prior to egg degradation egg morphometry measurements will not be possible.

Back in the laboratory, digital images of fresh eggs from each female will be taken with a digital camera attached to a compound microscope at appropriate magnification. Using image analysis software, egg area and maximum, minimum and average diameter will be measured. Once embryos are discernable, embryo area and yolk area will also be measured and percent yolk calculated. Lastly, for eyed embryos, eyespot area and maximum, minimum and average diameter will be measured.

Fecundity:

After the eggs are extracted for egg staging and egg morphometry a portion of the clutch (abdominal flap and eggs) should be frozen at -20 degrees C.

Eggs will be enumerated at NOAA AKFSC on the portion of the egg mass provided using dry weight methods. Embryos will be carefully stripped off of the pleopods and then two random samples of 250 embryos will be counted. The subsamples and remaining embryos will be dried at 60°C until a constant weight is achieved. Eggs will be enumerated by dividing the total dry weight of embryos by the average of the two estimates of individual embryo dry weight obtained from the subsamples. Fecundity will be determined by summing the numbers of eggs calculated in the subsample provided to NOAA AKFSC and the sub-sample provided to Alpha Analytical Laboratories for chemical analyses.

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Protected Species Interaction Prevention Procedures for No-impact Gear Types

For data collection efforts involving a number of gear types that are routinely deployed for measuring physical properties of the ocean or collecting plankton samples, the trustees and BP have determined that there will be no effect on protected species (endangered and threatened species, and marine mammals) under the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA) if deployed according to standard protocols.

Endangered and threatened species considered to potentially occur in the sampling area.

Common Name	Scientific Name	Status
leatherback sea turtle	*Dermochelys coriacea*	endangered
loggerhead sea turtle	*Caretta caretta*	threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	endangered
green sea turtle	*Chelonia mydas*	threatened
hawksbill sea turtle	*Eretmochelys imbricata*	endangered
sperm whale	*Physeter macrocephalus*	endangered

In depths greater than 200 m, Kemp's ridley, green, and hawksbill sea turtles are expected to occur in such low abundances that they are discounted from any potential effects occurring to these species. Leatherback and loggerhead sea turtles, and sperm whales are considered further for potential adverse effects. In addition, non-listed species of marine mammals are also considered for the potential of incidental capture and entanglement occurring,

These gear types considered for their potential to incidentally capture or entangle protected species include:

- CTD and rosette samplers and instruments attached to these arrays
- Radiometers
- Bongo nets
- Neuston nets
- Vertically deployed or towed imaging systems
- 1m MOCNESS
- 10m MOCNESS

CTD and rosette samplers (with associated instrument packages) and radiometers are typically deployed in a vertical cast. The instruments are deployed on a cable and have no loose lines or other entanglement hazards for protected species.

Bongo nets are typically deployed on a cable down to a depth of up to 200 m and neuston nets are deployed in the upper 1 m of the water column. The small size of these nets (neuston net 2 square meters, 2 bongo nets of 0.5 square meters each) and the lack of a loose line makes the likelihood of capture or entanglement of a marine mammal or sea turtle exceedingly small. In more than two decades of the SEAMAP program conducting bongo and neuston tows, no incidental captures of marine mammals or sea turtles have occurred.

Imaging systems such as the Digital Automatic Video Plankton Recorder (DAVPR) are either lowered vertically through the water column or towed on a conducting cable. The overall footprint of the instrument package is small and the wire is kept tight for proper deployment. No loose lines are present.

Neuston net – 2square meters
Bongos are each ½ square meter for a total of 1 square meter
Manta Neuston net – approximately 0.5 square meter

1m MOCNESS and 10m MOCNESS nets are deployed up to 2000m or more in depth (typically targeting 1500m). The net system is mounted on a rigid frame and no loose lines are hanging in the water. Although larger than bongo and neuston nets, these nets are still relatively small and only sweep a very small percentage of the water volume. The heavy, rigid frame results in a sinking rate of approximately 20m/s and thus the net is descending through the upper water column quickly. The nets are towed at 1.5 to 2.5 knots and tows last about 4 – 6 hours. Thus, for the 10m MOCNESS, the average volume swept in a deployment (assuming 1500m descent and a 5 hour tow at 2 knots) is approximately 215,000 cubic meters of water. Since sampling stations are on 30 nautical mile centers, the percentage of volume swept by a 10m MOCNESS, not including the volume below 1500m is 0.0000046% or approximately 1 in 215,165. Given that the most abundant turtle species, the leatherback has approximately 1 animal per 417 sq km of ocean in waters greater than 200m depth, if it is assumed that this density remains the same for waters in excess of 1500m, there are approximately 7.4 leatherbacks per 30 nm x 30 nm cell. Thus, if the animals were randomly distributed within the water volume and did not move, the probability of capturing one in the 10m MOCNESS is 1 in approximately 29,000 tows. Similarly, loggerheads are expected to be present at a density of about 1 animal per 500 square km and have a catch probability of 1 in 34,900 tows. However, since much of the tow time of the MOCNESS net is well below the foraging depth of turtles, the probability of capture is in fact, much lower.

Although a no impact determination on endangered species from these gear types has been made, and the likelihood of capture or entanglement of marine mammals in these gear types is exceedingly small during the deployment and retrieval of the nets from deep water tows, the following mitigating measures will be taken to assure that potential interactions with protected species are minimized to discountable levels.

1. **Marine mammal and sea turtle observers.** Prior to deploying any sampling equipment, at least one observer shall be established to keep dedicated watch for marine mammals and sea turtles. The observer's sole purpose shall be to scan for marine mammals or sea turtles, with a focus of monitoring 180 degrees in front of the vessel's course, prior to the deployment of sampling gear. Since the intent of scanning for marine mammals and turtles is to assure that the gear is not deployed if marine mammals or turtles are shipside, a visual scan of the deployment area should be conducted for at least 30 minutes prior to deploying sampling gear. During night deployments night-vision binoculars or deck lighting with the naked eye may be used for monitoring. If marine mammals or turtles are observed in the vicinity of the vessel, deployment of sampling gear should not occur until protected species are verified to be clear of the area, or if not resighted, 30 minutes

after the initial sighting, until the chief scientist, in consultation with the captain deem that it is safe to do so.

2. **Keep all cables tight on sampling gear.** Protected species may become entangled in loose lines associated with sampling gear. Dolphins are known to become entangled in lazy lines on shrimp trawl nets, float lines of trap/pot gear, and buoy lines of gillnet gear, etc. Although none of the gear types under consideration here have lazy lines or other rope types, and cables are unlikely to entangle protected species, lines should not be allowed to become slack.

3. **If protected species are observed during sampling.** It is possible that marine mammals or turtles will be observed after sampling gear has been deployed but before sampling is complete. Given the small size of nets, the slow ship speeds, and the other factors outlined above for these sampling gears, any injurious interaction between the sampling gear and a turtle or marine mammal is still extremely small. However, if an observation is made while gear is in the water, the proximity of the observed animal to the sampling gear should be closely monitored and the gear should be removed from the water if there appears to be any potential for capture or entanglement.

If a protected species take occurs, the following measures shall be conducted:

1. **Report any marine mammal capture/entanglement immediately.** Marine mammal entanglements (live or dead) must be reported immediately to 1-877-WHALE HELP (1-877-942-5343).

2. **Report any sea turtle capture/entanglement immediately.** Immediately report any sea turtle takes to takereport.nmfsser@noaa.gov or Bob Hoffman at the NMFS Southeast Regional Office (727-403-2641). In the event of any unauthorized takes of sea turtles, sampling should cease until the harm avoidance measures can be reviewed with NMFS Southeast Regional Office, Protected Resources Division, and modified as needed.

3. **In the event of a live animal capture/entanglement within sampling gear,** work from the vessel as quickly and carefully as possible to disentangle the animal for prompt release. Ensure the marine mammal's blowhole and sea turtle's mouth are kept at the surface to ensure it can continue to breathe while disentangling. If possible, the animal shall be identified, photographed, and released directly back into the water to avoid further injury from being brought aboard the ship. If the animal is not able to be released directly back into the water, the animal and sampling gear shall be carefully placed on the deck of the ship, preventing the animal from falling on the deck and becoming further injured. For turtles, follow the turtle resuscitation guidelines (attached). For marine mammals, ensure the animal's blowhole is free of obstructions and work quickly and carefully to return the animal to the water.

4. **In the event of a mortality,** the animal shall be retained and guidance shall be given on how to maintain the carcass. The Principal Investigator shall seek guidance from Wendy

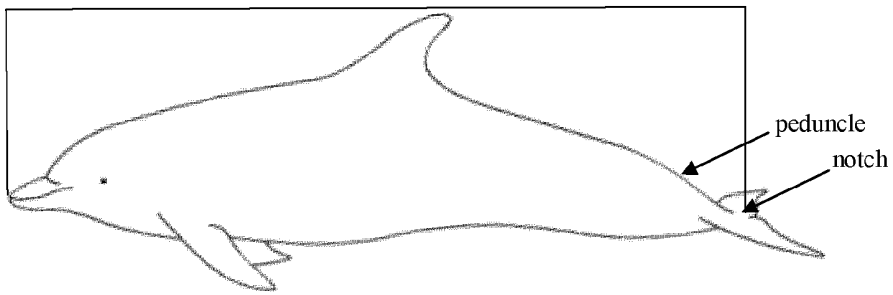
Teas (305-361-4595) for sea turtles and Blair Mase (305-361-4586) for marine mammals at the NMFS, Southeast Fisheries Science Center on how to retain the carcasses (i.e., whether they should be put in the cooler and immediately brought back to shore for sampling, or frozen for future sampling). Photos, measurements, and entanglement information shall also be documented per "NMFS' Protocol For Dead Entangled Small Cetaceans" attached or a sea turtle stranding form filled out and sent to Wendy Teas. Reports should also include whether mitigation measures were followed, and if not, an explanation provided.

NMFS' PROTOCOL FOR DEAD ENTANGLED SMALL CETECEANS

In the event of a small cetacean mortality that is incidentally captured, please document the following items:

1. Latitude and longitude of entanglement.
2. Photograph entire animal before removing from gear (with a scale bar if possible).
3. Photograph lateral view of dorsal fin (for photo-identification) with no gear (with a scale bar if possible).
4. Measure standard length (from tip of upper jaw to notch in the tail; see picture below).

Standard length



5. Photograph ventrum, including genital slits so sex can be determined (with a scale bar if possible).
6. After removal of gear, photograph any obvious signs of net impressions/lacerations or rope wounds (with a scale bar if possible).
7. Document where in the gear the animal was entangled/caught and how gear was wrapped around animal.
8. Document reason dolphin could not be hauled aboard the vessel.

Compiled by: Barbie L. Byrd, NNFS/SEFSC, Beaufort, NC and Stacey Horstman, NMFS/SERO, St. Petersburg, FL

Sea Turtle Resuscitation Guidelines

If a turtle appears to be unconscious or comatose, attempt to revive it before release. Turtles can withstand lengthy periods without breathing; a living comatose sea turtle may not move, breathe voluntarily, or show reflex responses or other signs of life. In other cases, a lightly comatose turtle may show shallow breathing or reflexes such as eyelid or tail movement when touched. Use the following method of resuscitation in the field if veterinary attention is not immediately available:

- Place the turtle on its plastron (lower shell) and elevate the hindquarters approximately 15 - 30 degrees to permit the lungs to drain off water for a period of 4 up to 24 hours. A board, tire or boat cushion, etc. can be used for elevation.

- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the carapace and lifting one side about 3 inches, then alternate to the other side.

- Keep the turtle in the shade, at a temperature similar to water temperature at capture. Keep the skin (especially the eyes) moist while the turtle is on deck by covering the animal's body with a wet towel, periodically spraying it with water, or by applying petroleum jelly to its skin and carapace. Do not put the turtle into a container with water.

- Do not put the turtle on its carapace (top shell) and pump the plastron (breastplate) or try to compress the turtle to force water out, as this is dangerous to the turtle and may do more harm than good.

- Periodically, gently touch the corner of the eye or eyelid and pinch the tail near the vent (reflex tests) to monitor consciousness.

- Sea turtles may take some time to revive; do not give up too quickly. Turtles that are successfully resuscitated benefit from being held on deck as long as possible (up to 24 hours) to fully recover from the stress of accidental forced submergence.

- Release successfully resuscitated turtles over the stern of the boat, when fishing or scientific collection gear is not in use, the engine is in neutral, and in areas where they are unlikely to be recaptured or injured by vessels. A turtle that has shown no sign of life after 24 hours on deck may be considered dead and returned to the water in the same manner.

NMFS/SEFSC Photos

References:

Federal Register, December 31, 2001. Government Printing Office, Washington DC 66 (250), pp. 67495- 67496.

July 2009

INSTRUCTIONS FOR COMPLETING STSSN STRANDING REPORT FORMS

OBSERVER'S NAME/ADDRESS/ PHONE: This is the person who handled the turtle in the field. Please give an address and phone number where you can be reached in the event we need to contact you for clarification of the reported data.

STRANDING DATE: This is the date the stranded turtle was first reported or encountered. If you did not investigate until a later date, please note that in the remarks section at the bottom of the form. "Turtle Number by Day" is used to keep track of more than one turtle investigated on a single day by the same volunteer – your first turtle of the day is 01, second of the same day is 02, etc. Please notify the state coordinator within 24 hours for any strandings you document and check the box describing how the coordinator was notified.

SPECIES: Use the species identification key on the back of the form to positively determine species. If you are not positive of the species identification, check "Unidentified", please do not guess. Check boxes to indicate if photos were taken and if the state coordinator verified species. The state coordinator may verify species based on photos taken and submitted with the stranding report form.

SEX: Check appropriate box(es). Sea turtles cannot be sexed externally until they are mature adults. If the turtle is not adult-sized (generally at least 92 cm straight length for loggerheads and green turtles, 60 cm straight length for Kemp's ridleys, 80 cm straight length for hawksbills and 130 cm curved length for leatherbacks) then you should check "immature, undetermined" if the turtle is not necropsied. Some males may begin to mature at slightly smaller sizes than those listed above and tail length should be documented if it is being used to externally sex a turtle.

STRANDING LOCATION: Check "Offshore" if the turtle was found on an ocean beach or "Inshore" if the turtle was in a bay, river, sound, inlet, etc. Give a detailed descriptive location of the stranding using a reference point that can be found on a NOAA navigation chart. Local names or landmarks not found on most charts do not help pinpoint a location. **Good reference points are inlets, fishing piers, light houses, water tanks, etc.** Latitude/Longitude – if you have a GPS unit or are familiar with latitudes and longitudes and you have a navigation chart, please include the latitude/longitude of the stranding location. If you cannot provide accurate lat/longs, please leave this space blank. It then becomes even more important to provide a location description than can be pinpointed on a chart.

CONDITION: Check the box that best describes the stranding. If the turtle seems intermediate between two stages of decomposition, pick the one that fits best. Fresh dead turtles should have no foul smell; moderately decomposed turtles smell bad, but skin and scutes are intact or are only beginning to peel, internal organs are still distinguishable; severely decomposed turtles smell very bad with scutes lifting or gone and skin beginning to peel or liquefy, internal organs beginning to liquefy, hard to distinguish individual organs; dried carcasses, leathery, internal organs completely decomposed.

FINAL DISPOSITION: Check the box(es) next to the number that best describes what was done with the stranding after it was documented on the beach. Provide additional information regarding salvaged specimens. Record what rehabilitation facility live turtles were taken to.

TAGS: **Contact state coordinator before disposing of any tagged animal!!**
Flipper tags – check all flippers on all species and record information; note also if tag scars are seen.
PIT tags – scan front flippers and shoulder areas of all species (see PIT tag scanning protocol for specific instructions).
Coded wire tag scan – currently only being placed in front flipper region of Kemp's ridleys (see wire tag scanning protocol for specific instructions). Both front flippers and associated shoulder and "armpit" areas of all Kemp's ridleys should be salvaged for later scanning if a magnetometer is not available).
Living tags – check all Kemp's ridleys for light-colored areas on the dark carapace. Living tags are tissue transplants of the plastron onto the carapace which grow with the turtle and were used to

mark headstarted turtles to distinguish between different ages. If you suspect a living tag is present the entire carcass should be salvaged. In most cases, Kemp's ridleys with living tags were also marked with external flipper tags, PIT tags and coded wire tags as well. The Cayman Turtle Farm has also used living tags on some green turtles to distinguish age and a couple of these have been documented by the STSSN; these turtles should have external flipper tags or tag scars as well.

CARAPACE MEASUREMENTS: Use calipers to obtain straight measurements and/or flexible, non-metal measuring tape to obtain curved measurements. Measurement points are noted on drawings on left side of form. Circle units of measure – centimeters or inches; if units are not circled we cannot include measurements in the database.

REMARKS SECTION AT BOTTOM OF FORM: Mark wounds/abnormalities on the diagrams at left and describe in detail. The more information you include, the easier it will be for us to code the record. Use the back of the data sheet to continue your remarks if needed. Always note anything unusual about a stranding event.

SEA TURTLE STRANDING AND SALVAGE NETWORK – STRANDING REPORT

OBSERVER'S NAME / ADDRESS / PHONE:
First _____ M.I.____ Last _____
Affiliation _____
Address _____
_____
Area code/Phone number _____

STRANDING DATE:
Year 20☐☐ Month ☐☐ Day☐☐
Turtle number by day ☐☐

Coordinator must be notified within 24 hrs; this was done by ☐***phone*** ☐***email*** ☐***fax***

SPECIES: (check one)
- ☐ CC = Loggerhead
- ☐ CM = Green
- ☐ DC = Leatherback
- ☐ EI = Hawksbill
- ☐ LK = Kemp's Ridley
- ☐ LO = Olive Ridley
- ☐ UN = Unidentified

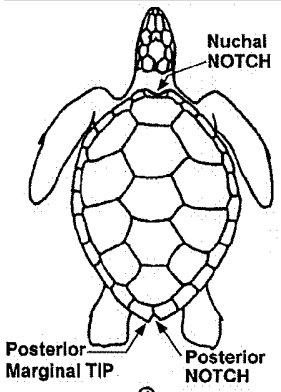
Check Unidentified if not positive. Do Not Guess.

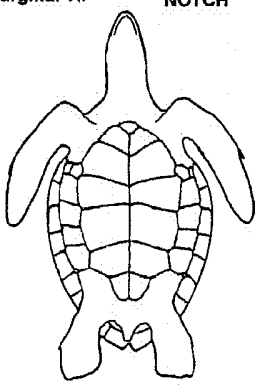
Carcass necropsied? ☐Yes☐No
Photos taken? ☐Yes ☐No
Species verified by coordinator?
☐ Yes ☐ No

SEX:
- ☐ Undetermined
- ☐ Female ☐ Male

Does tail extend beyond carapace?
- ☐ Yes; how far?_____ cm / in
- ☐ No

How was sex determined?
- ☐ Necropsy
- ☐ Tail length (adult only)





STRANDING LOCATION: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
State _____ County/Parrish_____
Descriptive location (be specific)_____
_____
_____
Latitude _____ Longitude _____

CONDITION: (check one)
- ☐ 0 = Alive
- ☐ 1 = Fresh dead
- ☐ 2 = Moderately decomposed
- ☐ 3 = Severely decomposed
- ☐ 4 = Dried carcass
- ☐ 5 = Skeleton, bones only

TAGS: ***Contact coordinator before disposing of any tagged animal!!***
Checked for flipper tags? ☐ Yes ☐ No
Check all 4 flippers. If found, record tag number(s) / tag location / return address
_____
_____
_____

PIT tag scan? ☐ Yes ☐ No
If found, record number / tag location
_____
_____

Coded wire tag scan? ☐ Yes ☐ No
If positive response, record location (flipper)
_____

Checked for living tag? ☐Yes ☐ No
If found, record location (scute number & side)
_____

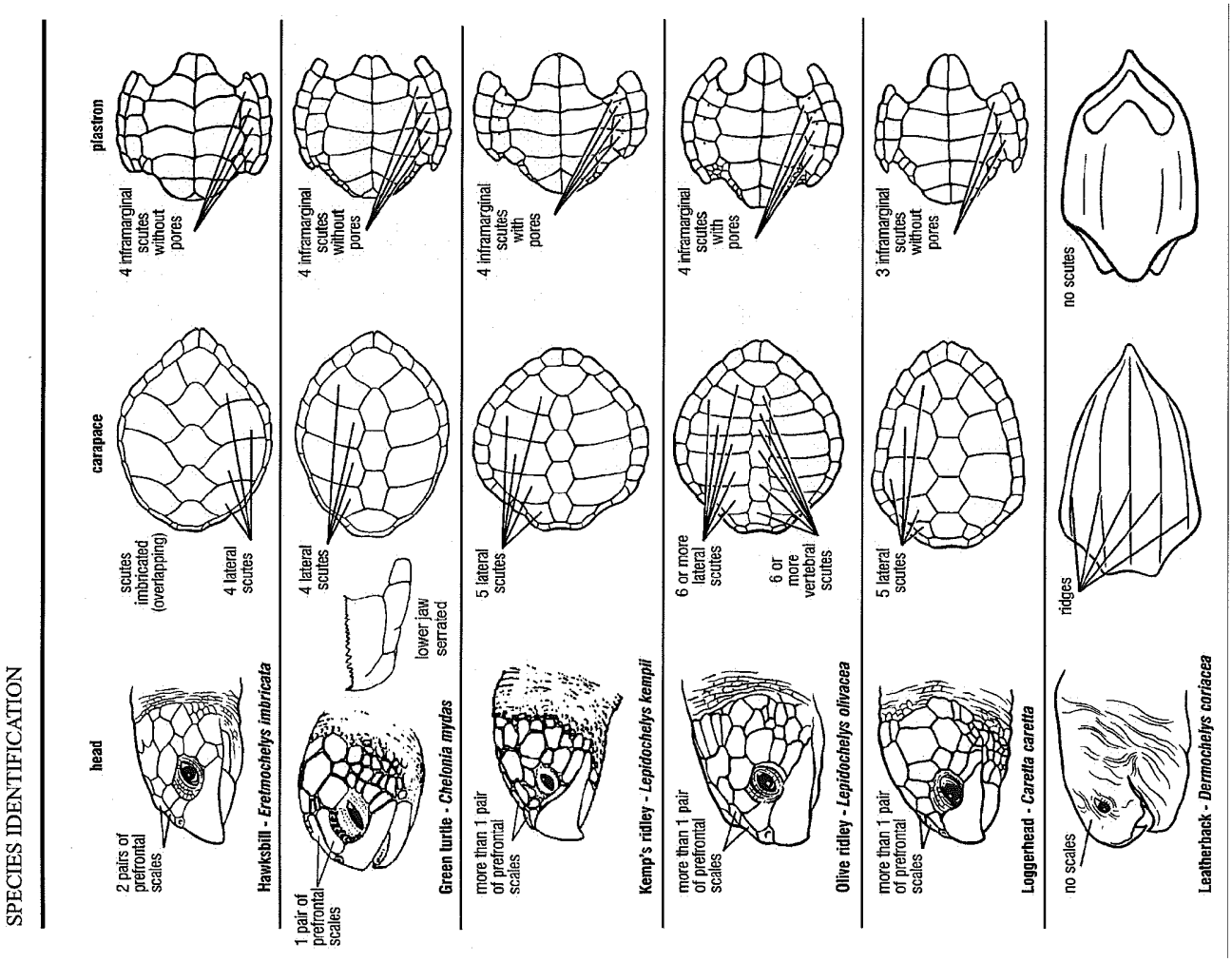
FINAL DISPOSITION: (check)
- ☐1 = Left on beach where found; painted? ☐Yes* ☐No(5)
- ☐2 = Buried: ☐ on beach / ☐ off beach; carcass painted before buried? ☐ Yes* ☐ No
- ☐3 = Salvaged: ☐ all / ☐ part(s), what/why? _____
  _____
  _____
- ☐4 = Pulled up on beach/dune; painted? ☐Yes* ☐No
- ☐6 = Alive, released
- ☐7 = Alive, taken to rehab. facility, where? _____
  _____
- ☐8 = Left floating, not recovered; painted? ☐Yes* ☐No
- ☐9 = Disposition unknown, explain _____
  _____

If painted, what color? _____

CARAPACE MEASUREMENTS: (*see drawing*)

Using calipers		**Circle unit**
Straight length (NOTCH-TIP)	_____	cm / in
Minimum length (NOTCH-NOTCH)	_____	cm / in
Straight width (Widest Point)	_____	cm / in
Using non-metal measuring tape		**Circle unit**
Curved length (NOTCH–TIP)	_____	cm / in
Minimum length (NOTCH-NOTCH)	_____	cm / in
Curved width (Widest Point)	_____	cm / in
		Circle unit
Weight ☐ actual / ☐ est.	_____	kg / lb

Mark wounds / abnormalities on diagrams at left and describe below (note tar or oil, gear or debris entanglement, propeller damage, epibiota, papillomas, emaciation, etc.). **Please note if no wounds / abnormalities are found.**
_____
_____
_____
_____
_____
_____



Please use an envelope and mail original form to:

APPROPRIATE STATE STSSN COORDINATOR

A list of these state coordinators can be found at

http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp

Vessel Strike Avoidance Measures and Reporting for Mariners NOAA Fisheries Service, Southeast Region

Background
The National Marine Fisheries Service (NMFS) has determined that collisions with vessels can injure or kill protected species (e.g., endangered and threatened species, and marine mammals). The following standard measures should be implemented to reduce the risk associated with vessel strikes or disturbance of these protected species to discountable levels. NMFS should be contacted to identify any additional conservation and recovery issues of concern, and to assist in the development of measures that may be necessary.

Protected Species Identification Training
Vessel crews should use an Atlantic and Gulf of Mexico reference guide that helps identify protected species that might be encountered in U.S. waters of the Atlantic Ocean, including the Caribbean Sea, and Gulf of Mexico. Additional training should be provided regarding information and resources available regarding federal laws and regulations for protected species, ship strike information, critical habitat, migratory routes and seasonal abundance, and recent sightings of protected species.

Vessel Strike Avoidance
In order to avoid causing injury or death to marine mammals and sea turtles the following measures should be taken when consistent with safe navigation:

1. Vessel operators and crews should maintain a vigilant watch for marine mammals and sea turtles to avoid striking sighted protected species.

2. When whales are sighted, maintain a distance of 100 yards or greater between the whale and the vessel.

3. When sea turtles or small cetaceans are sighted, attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.

4. When small cetaceans are sighted while a vessel is underway (e.g., bow-riding), attempt to remain parallel to the animal's course. Avoid excessive speed or abrupt changes in direction until the cetacean has left the area.

5. Reduce vessel speed to 10 knots or less when mother/calf pairs, groups, or large assemblages of cetaceans are observed near an underway vessel, when safety permits. A single cetacean at the surface may indicate the presence of submerged animals in the vicinity; therefore, prudent precautionary measures should always be exercised. The vessel should attempt to route around the animals, maintaining a minimum distance of 100 yards whenever possible.

6. Whales may surface in unpredictable locations or approach slowly moving vessels. When an animal is sighted in the vessel's path or in close proximity to a moving vessel and when safety permits, reduce speed and shift the engine to neutral. Do not engage the engines until the animals are clear of the area.

Additional Requirements for the North Atlantic Right Whale

1. If a sighted whale is believed to be a North Atlantic right whale, federal regulation requires a minimum distance of 500 yards be maintained from the animal (50 CFR 224.103 (c)).

2. Vessels entering North Atlantic right whale critical habitat are required to report into the Mandatory Ship Reporting System.

3. Mariners should check with various communication media for general information regarding avoiding ship strikes and specific information regarding North Atlantic right whale sighting locations. These include NOAA weather radio, U.S. Coast Guard NAVTEX broadcasts, and Notices to Mariners. Commercial mariners calling on United States ports should view the most recent version of the NOAA/USCG produced training CD entitled "A Prudent Mariner's Guide to Right Whale Protection" (contact the NMFS Southeast Region, Protected Resources Division for more information regarding the CD).

4. Injured, dead, or entangled right whales should be immediately reported to the U.S. Coast Guard via VHF Channel 16.

Injured or Dead Protected Species Reporting

Vessel crews should report sightings of any injured or dead protected species immediately, regardless of whether the injury or death is caused by your vessel.

Report marine mammals to the Southeast U.S. Stranding Hotline: 877-433-8299
Report sea turtles to the NMFS Southeast Regional Office: 727-824-5312

If the injury or death of a marine mammal was caused by a collision with your vessel, responsible parties should remain available to assist the respective salvage and stranding network as needed. NMFS' Southeast Regional Office should be immediately notified of the strike by email (takereport.nmfsser@noaa.gov) using the attached vessel strike reporting form.

For additional information, please contact the Protected Resources Division at:

NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
Tel: (727) 824-5312
Visit us on the web at http://sero.nmfs.noaa.gov

Deep Benthic Communities and Water Column Ephemeral Data Collections:
Deepwater Horizon Oil Spill (DWHOS)

HOS Sweet Water 4/6, Seep Flux Quantification Testing
July 14, 2011

An ROV-deployable chamber for seep flux measurements will be tested during the HOS Sweet Water 4 and 6 cruises in July-September 2011. The basic design is that of an inverted funnel with a footprint of approximately 3 feet by 1.5 feet. This document describes the the Trustees' theory, design, and anticipated deployment of the chamber, as well as its intended experimental deployment during the HOS Sweet Water 4/6 cruise in July 2011.

The system is designed to work as follows: It is deployed over a seep for a defined period of time, and the hydrocarbons are quantitatively captured inside the device and held by their buoyancy. However, flux cannot be measured this way within the gas hydrate stability field (i.e., at depths where the gas forms hydrates) because of the rapid hydrate nucleation, so instead the ROV is then brought up to a depth where gas hydrate is not stable, and the free gas is released. The expansion of the gas in the device (a clear, calibrated chamber) and hydrostatic pressure are monitored and used to calculate a molar quantity of gas. When combined with the deployment time, this is expected to yield the gas flux for that seep. Oil flux is measured in this fashion and concurrently, but by using visually-determined layer thickness in reference to a calibrated scale. Alternatively, sorbent materials can be placed in the chamber and used to sorb the oil (which could later be extracted and quantified). This approach has been applied for gas measurement in the hydrate stability field, but modifications are needed to account for concurrent gas and oil flux of unknown proportions. The HOS Sweet Water 4 and 6 cruises will be used to test this approach on seeps in the vicinity of MC 252, such that the design of the system can be modified for subsequent seep-focused cruises.

The flux system will be deployed on an experimental basis during the designated seep dives outlined in the main HOS Sweet Water 4/6 sampling plan. One chamber will be brought to the sea floor as payload on the ROV basket. This will require alteration to the front basket of the ROV, likely requiring removal of the slurp chambers, which are not slated for use on the designated seep dives. The ROV will conduct the operations as described in the cruise plan, except that the hydrocarbon flux will be measured at the central venting features at the identified seeps. The flux measurement will be performed after the area survey, but prior to coring within the seep, as coring may temporarily and locally alter the hydrocarbon flux. One measurement is expected to take 30 minutes, and each subsequent measurement is expected to take 75 minutes. One measurement is quicker because the measurement can be made

during the final ascent of the ROV, thus obviating the need to raise and lower the ROV. The longer timing includes moving into position, deploying the flux device with the manipulator of the ROV, collecting the sample, re-securing the flux device, bringing to the ROV to a depth outside of the hydrate stability field to make the measurement, and returning the ROV to the seep. Most of the time required is to raise and lower the ROV.

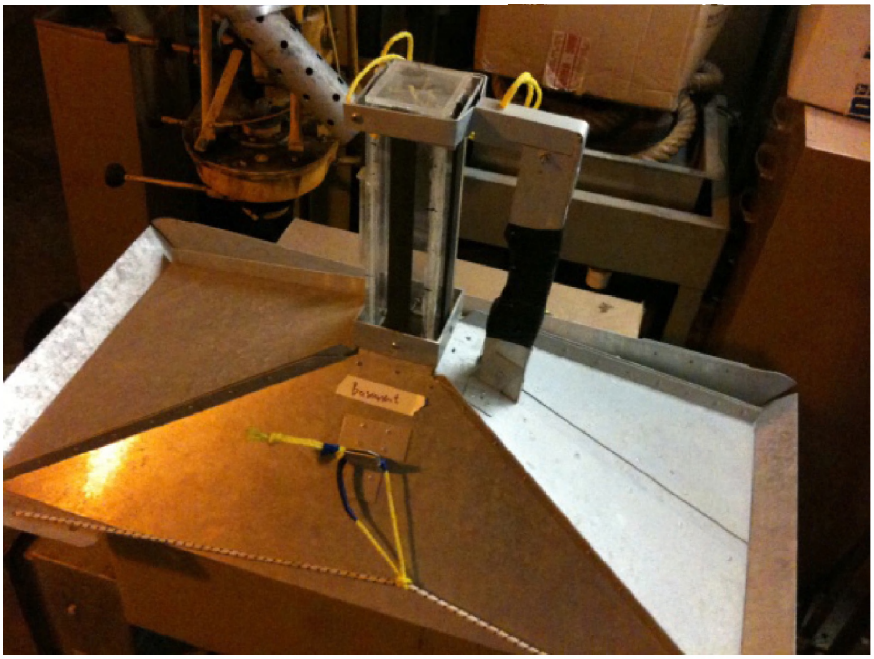


Figure 1. Prototype seep flux quantification device.

This chamber design has been used previously to quantify gas flux from shallow water seeps and from a seep located within the hydrate stability field, with success. A variety of modifications were made in an effort to enable use within the hydrate stability field, and the measurement itself benefits from experience with seep flux measurements, particularly for designating the collection time, and recognizing the phase changes of hydrate associated with the endothermic dissociation reaction. Previous use of this design was on a submarine, and several benefits are expected from ROV deployment, most notably the capability to make multiple measurements on each deployment.